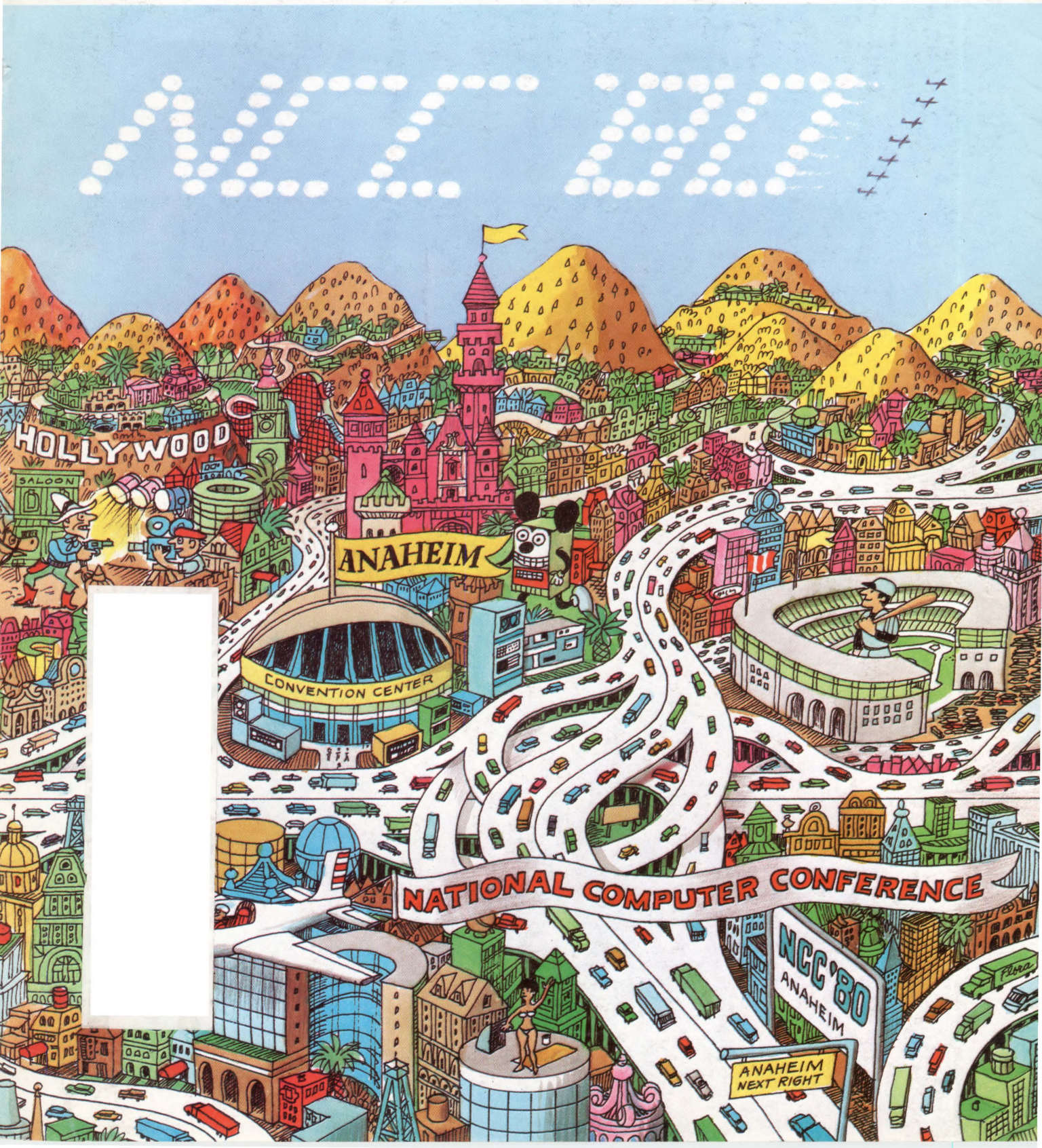
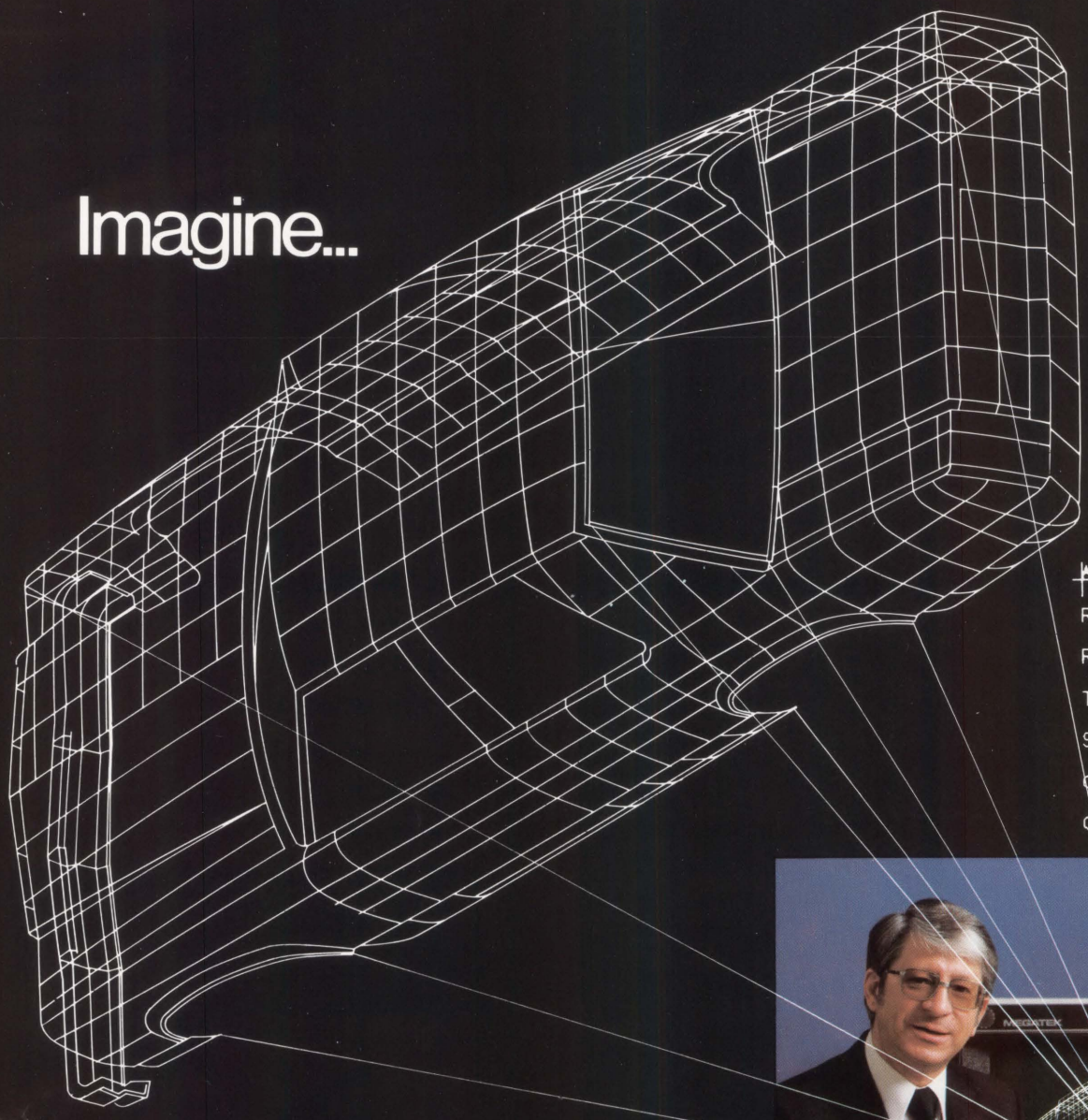
COMPUTER DESIGN

THE MAGAZINE OF
COMPUTER-BASED SYSTEMS

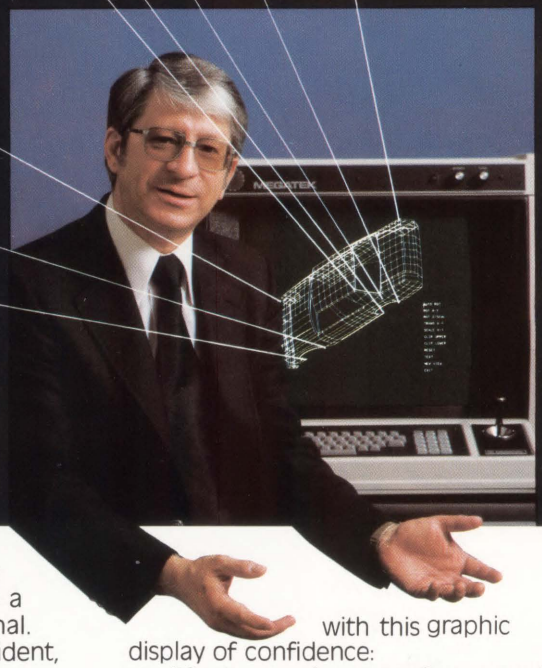
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CIRCLE 3 ON INQUIRY CARD

COMPUTER DESIGN
THE MAGAZINE OF
COMPUTER-BASED SYSTEMS

VOLUME 19, NUMBER 5 MAY 1980

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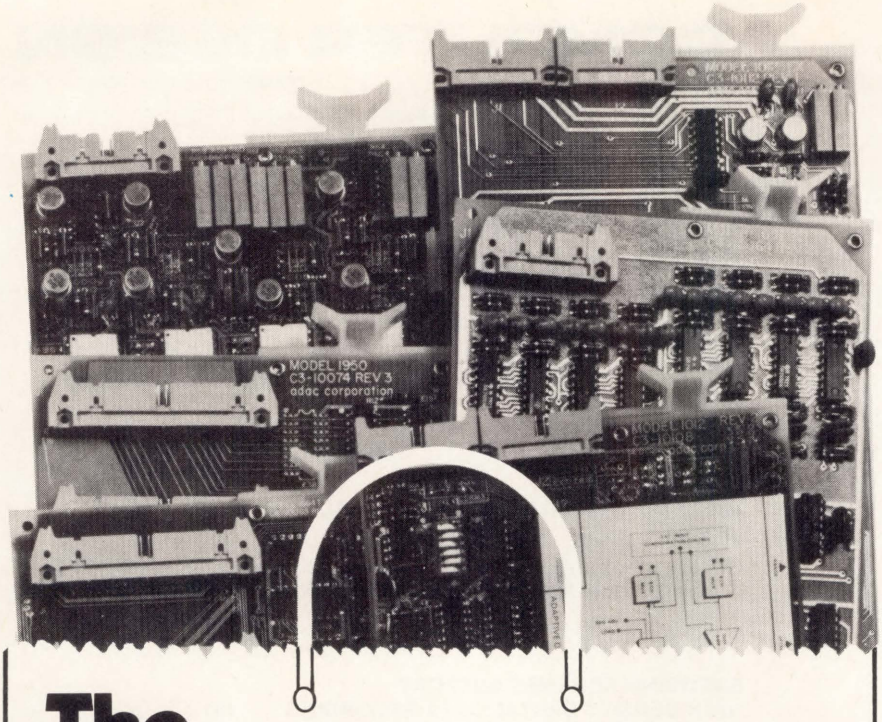
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Several hundred manufacturers and computer industry related companies are exhibiting their products and services at NCC '80, some at the Anaheim Convention Center and others at the Disneyland Hotel complex. To assist those readers who will attend NCC '80, *Computer Design* has highlighted many of the products being introduced at the conference



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1632TTL 32 TTL I/O lines
1664TTL 64 TTL I/O lines

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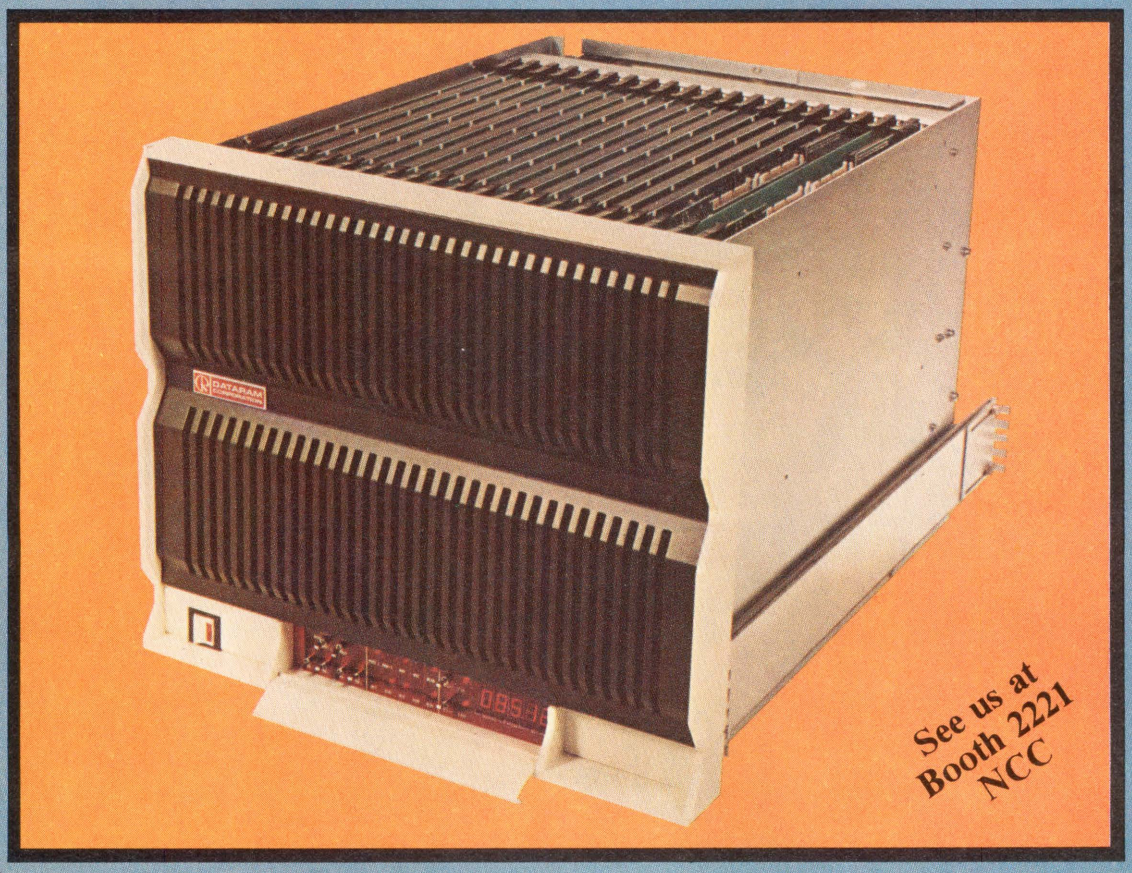
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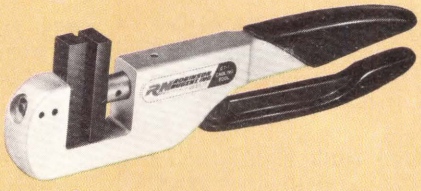
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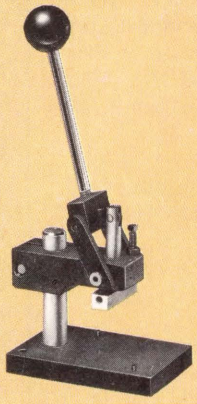
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CALENDAR

CONFERENCES

JUNE 2-5—Sym on Incremental Motion Control Systems and Devices, Ramada Inn, Champaign, Ill. INFORMATION: Prof B. C. Kuo, IMCSS, PO Box 2772, Station A, Champaign, IL 61820. Tel: 217/333-4341

JUNE 3-5—Sym on Multiple-Valued Logic, Northwestern U, Evanston, Ill. INFORMATION: Jon T. Butler, Dept of Electrical Engineering and Computer Science, Northwestern U, Evanston, IL 60201. Tel: 312/492-5628

JUNE 8-11—Internat'l Conf on Communications, Red Lion Inn, Seattle, Wash. INFORMATION: ICC '80, PO Box 88465, Seattle, WA 98188

JUNE 16-18—ATE Seminar/Exhibit, Hynes Auditorium, Boston, Mass. INFORMATION: ATE Seminar/Exhibit, c/o Benwill Publishing Corp, 1050 Commonwealth Ave, Boston, MA 02215. Tel: 617/232-5470

JUNE 19—Computer System Integrity, Technical Sym of the ACM and NBS Institute for Computer Sciences and Technology, National Bureau of Standards, Gaithersburg, Md. INFORMATION: Angela Turvey, 4910 Butternut Dr, Rockville, MD 20853

JUNE 23-25—Design Automation Conf, Minneapolis, Minn. INFORMATION: E. B. Hassler, Texas Instruments, Inc, PO Box 225621, MS 3907, Dallas, TX 75265. Tel: 214/238-5781

AUG 12-14—Computer Graphics 80 Internat'l Conf and Exhibition, Birmingham, England. INFORMATION: Paula Stockham, Online, Cleveland Rd, Uxbridge UB8 2DD, England

AUG 18-21—Nat'l Conf on Artificial Intelligence, Stanford U, Stanford, Calif. INFORMATION: American Ass'n for Artificial Intelligence, Stanford U, PO Box 3036, Stanford, CA 94305

SEPT 15-18—1980 European Solid State Device Research Conf, U of York, York, England. INFORMATION: Clive Jones, The Institute of Physics, 47 Belgrave Sq, London, SW1X 80X, England

SEPT 16-18—WESCON, Anaheim Convention Ctr, Anaheim Calif. INFORMATION: Dale Litherland, Electronic Conventions, Inc, 999 N Sepulveda Blvd, El Segundo, CA 90245. Tel: 213/772-2965

SEPT 23-25—COMPCON Fall '80, Capitol Hilton, Washington, DC. INFORMATION: COMPCON 80 Fall, PO Box 639, Silver Spring, MD 20901

SEPT 25-28—Mid-Atlantic Personal and Business Computer Show, Philadelphia Civic Ctr, Philadelphia, Pa. INFORMATION: National Computer Shows, PO Box 678, Brookline Village, MA 02147. Tel: 617/524-0000

OCT 6-9 AND OCT 14-17—8th World Computer Congress, Tokyo, Japan, and Melbourne, Australia. INFORMATION: AFIPS, 1815 N Lynn St, Suite 800, Arlington, VA 22209. Tel: 703/243-4100

SEMINARS

JUNE 4-5 AND JULY 24-25—Microprocessors: Hardware, Software, and Applications, AND JUNE 18-19—Distributed Processing and Multiprocessing: Components and Applications, Holiday Inn, Boston, Mass, Worcester Polytechnic Institute, Worcester, Mass, and Sheraton Tara, Framingham, Mass. INFORMATION: Ginny Bazarian, Office of Continuing Education, Worcester Polytechnic Institute, Worcester, MA 01609

JULY 21-23 AND AUG 11-13—Digital Filtering and Control AND JUNE 23-25, JULY 14-16, AND AUG 18-20—Error Correcting and Detecting Codes with Applications to Computer System Design, Los Angeles, Calif and Palo Alto, Calif and Washington, DC, Los Angeles, Calif, and Palo Alto, Calif. INFORMATION: Hellman Associates, 299 S California Ave, Palo Alto, CA 94306. Tel: 415/328-4091

SHORT COURSES

JUNE 23-26 AND JULY 14-17—PLZ Programming; JUNE 2-5, JUNE 30-JULY 3, AND JULY 28-31—The Z8000; JUNE 10-11—Z8000 Emulation; AND JULY 21-23—Pascal Programming, Chicago, Ill, and Cupertino, Calif; Cupertino, Calif, Chicago, Ill, and Dallas, Tex; Cupertino, Calif; and Cupertino, Calif. INFORMATION: Karen Carothers, Zilog, 10460 Bubb Rd, Cupertino, CA 95014. Tel: 408/446-4666

JUNE 10-12—Communications Protocols and Computer Networking AND JUNE 17-20 AND AUG 12-15—Data Base Management Systems, Santa Monica, Calif. INFORMATION: Computer Technology Institute, 1024 Pico Blvd, Suite 101, Santa Monica, CA 90405. Tel: 213/376-3003

JUNE 16-27—Computer Techniques for Real-Time Control and Monitoring of Power Systems, U of Wisconsin, Madison, Wis. INFORMATION: Willis F. Long, Dept of Engineering, U of Wisconsin-Ext, 432 N Lake St, Madison, WI 53706. Tel: 608/262-1199

JUNE 23—Digital Electronics for Scientists and Engineers: A Home-and-Away Laboratory Course; JUNE 24-26—Microcomputers for Scientists and Engineers: A Laboratory Course; AND JUNE 27-28—Asynchronous Serial Communications and Programmable Interface Chips: A Laboratory Course, Virginia Polytechnic Institute and State U, Blacksburg, Va. INFORMATION: Dr Peter R. Rony, Virginia Polytechnic Institute, Blacksburg, VA 24061. Tel: 703/961-6370

JULY 7-18—Programming Methodology; JULY 14-18—Computer System Performance Prediction; JULY 14-18—Design and Implementation of Modular Programs; AND JULY 23-29—Operating Systems, U of California, Santa Cruz, Calif. INFORMATION: Joleen Kelsey Barnhill, U of California Extension, Carriage House, Santa Cruz, CA 95064. Tel: 408/429-2614

JULY 14-16—TRS-80 Radio Shack Computer Interfacing and Application for Scientific Instrumentation AND JULY 17-19—Motorola 6801 Single Chip Microcomputer Design, Interfacing and Applications, Virginia Tech Facility at Dulles Airport, Washington, DC. INFORMATION: Dr Linda Leffel, CEC, Virginia Tech, Blacksburg, VA 24061. Tel: 703/961-5241

JULY 14-25—Introduction to Microcomputer Interfacing, Virginia Military Institute, Lexington, Va. INFORMATION: Dr Philip B. Peters, Dept of Physics, VMI, Lexington, VA 24450. Tel: 703/463-6225

AUG 4-8—Machine Vision, Automatic Assembly, and Productivity Technology, U of Hamburg, West Germany. INFORMATION: Prof B. K. P. Horn, Artificial Intelligence Laboratory, 545 Technology Sq, Cambridge, MA 02139. Tel: 617/253-6218

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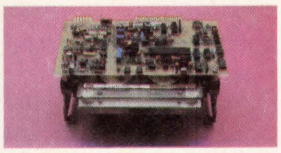
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CIRCLE 8 ON INQUIRY CARD

UPDATING THE SNA/PACKET-SWITCHING NETWORK DEBATE

Howard Frank
Network Analysis Corporation, Great Neck, New York

Before the introduction of Systems Network Architecture in 1974, IBM had more than 200 communications products requiring 35 teleprocessing access methods and 15 different data link control procedures. The goal of the new architecture was to provide a unified approach to IBM networking by introducing a single standard host access method and link control procedure. Use of these standards would achieve terminal compatibility at the communications line level as well as independence between network devices (eg, terminals) and host applications. This represented a major step forward in IBM's recognition of networks as a vital element of future computing systems. Systems Network Architecture, as orginally proposed and implemented, was a sophisticated architecture designed primarily for centralized teleprocessing (Fig 1).

At approximately the same time as Systems Network Architecture (SNA) was offered to the world, packet switching was becoming accepted by sophisticated data communications specialists as the immediate answer to the problem of allowing dissimilar computers and terminals to communicate. As a technology, packet switching differed radically from SNA in many respects, including its sharp separation of data processing from communications and the power of its networking capabilities. Relative merits of the two approaches have been often discussed and debated during the last five years. With the rapid growth of private networks, it is of great importance to update this discussion.

SNA was a major step forward in IBM's recognition of networks as a vital element of future computing systems

Numerous detailed descriptions of how SNA and packet-switching systems operate have been published and need not be repeated here. However, SNA as a conceptual architecture is difficult to analyze without discussing its various implementations, which, incidentally, have changed substantially since SNA was first announced. Recent SNA announcements have extended the implementation of the architecture to operate in a multihost environment (Fig 2) by incorporating in the access method at the host and frontend an Advanced Communication Function (ACF), and by increasing system networking capabilities.

SNA releases scheduled for 1980 and 1981 are introducing significant improvements

The advantages of SNA are derived primarily from the use of a consistent, unified architecture in place of the *ad hoc* procedures of the past. Use of full-duplex synchronous data link control (SDLC) terminals allows more efficient utilization of communication lines, yielding fewer lines and lower line costs. Independence of applications and network hardware, including terminals, permits different applications to use the same terminals, and reduces the number of terminals needed to perform a set of functions. Furthermore, a somewhat reduced load on the main CPU can be achieved through offloading to frontend processors, controllers, and intelligent terminals.

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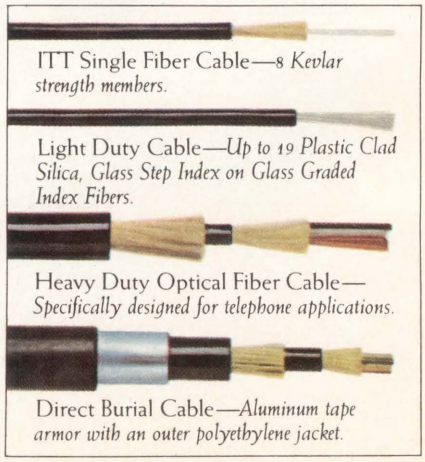
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Originally, the disadvantages of SNA, when compared to packet switching, related primarily to three factors: the cost of increased memory and processing at the host, the cost of upgrading from more primitive terminals, and the conversion cost incurred by moving to a full SNA implementation. Developments over the last two years have reduced these disadvantages considerably. First, IBM has backed away from its original intent to support only SDLC terminals in SNA systems; both binary synchronous and start/stop terminals are now accommodated. Additionally, the costs of new SDLC terminals from IBM are usually comparable to older bisync models. Second, recent major reductions in the cost of memory and CPU hardware have largely eliminated the penalty of greater memory and processing costs.

Additional problems and issues associated with SNA have related to the strong influence and control of the network by the host rather than by a frontend or a general purpose communications processor. This architecture makes it impossible to effect direct terminal to terminal communications without passing through an intermediate host. Other problems which stemmed from the strong host involvement were the complex network definition procedure required when the original system software was generated, the operational difficulty of implementing changes to network structures and software, and the difficulty of using SNA in a multiple host environment. This last problem impacts reliability since current implementations of SNA do not have automatic alternate routing capabilities; it also inhibits the use of resources across software-defined host domains. SNA releases scheduled for 1980 and 1981 have addressed many of these problems and are introducing significant improvements. Thus, SNA Release 4.1 will allow alternate routing and dynamic configuration so that terminals and clusters can be added or deleted online without the need to

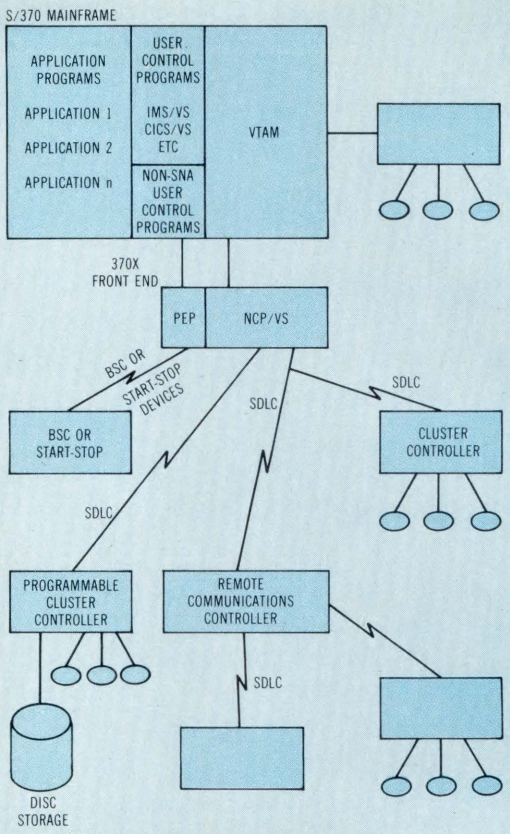


Fig 1 Typical SNA configuration

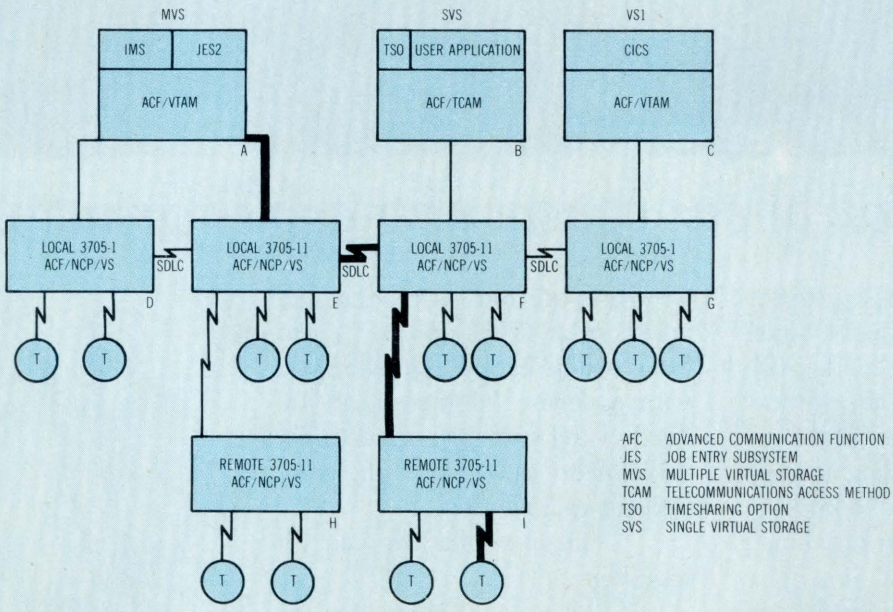
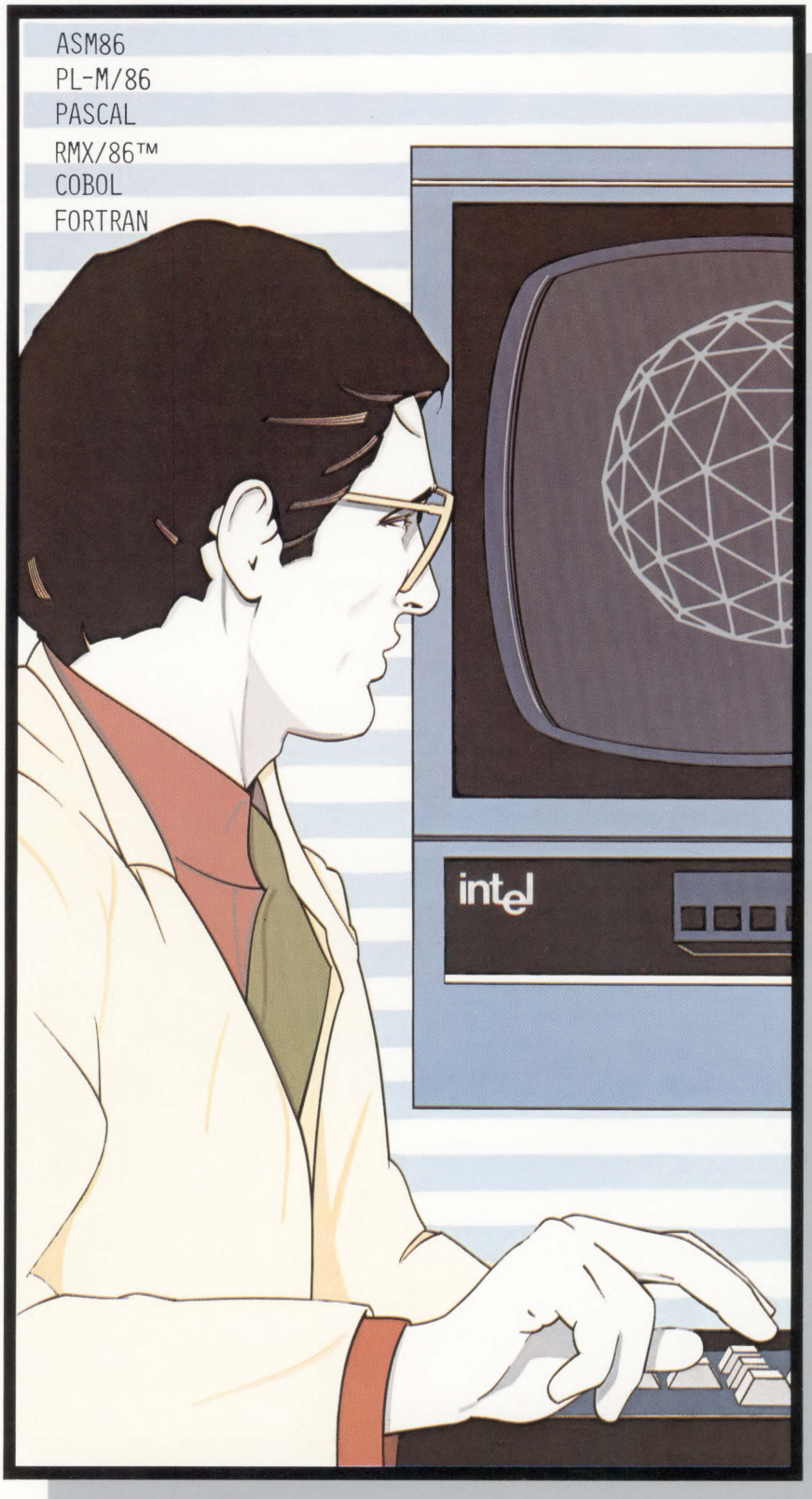


Fig 2 SNA multisystem configuration with ACF

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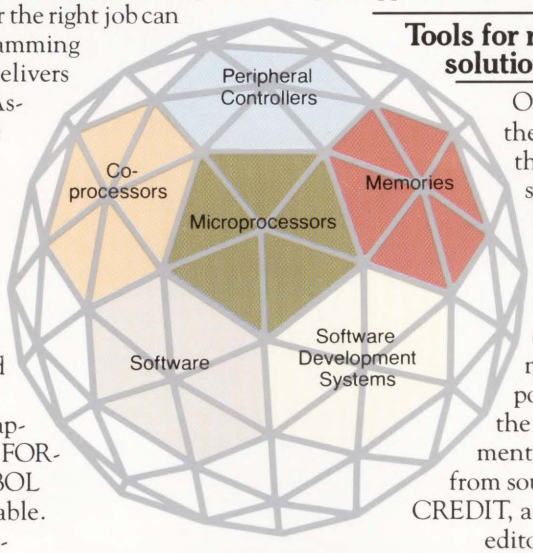
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regenerate the original software. Future releases have added the concept of a "Transmission Group" whereby a set of parallel links between nodes may be considered by the routing mechanism. In this way all satellite links might be placed in one group and low delay links of the same speed could be placed in another. Moreover, the concept of priorities has been added to allow more dynamic route selection. SNA Release 4.1 will also provide enhanced terminal support through an expanded set of devices including Series 1, the 8100, and others.

SNA as a philosophical approach is an elegant and important step forward from IBM's previous networking techniques. However, in judging SNA it is necessary to separate its philosophy from its implementation and herein lie its primary shortcomings. SNA implementations differ sharply from those of packet switching in their reliance on large host processors for network operation.

Starting with ARPANET, most packet-switched networks created a sharp separation between the host(s) and the network (Fig 3). The original ARPANET design effected this separation through the development of a packet-switching node originally based on a Honeywell 516 minicomputer. The 516 was later replaced by a 316, and descendants of ARPANET such as TELENET have used packet switches developed by Prime Computer and, most recently, Digital Communications Corp. The Tymnet approach uses a minicomputer switching node called the "Tymnet Engine," whose power can be augmented by "frontending" it with microprocessor interface units. With these packet switches in place, all hosts could disappear from the network and its full communications capability would remain intact. Under SNA, eliminating the hosts is equivalent to eliminating the network. Although a 1973 ARPANET packet switch implemented more network functions than does a current 1979 IBM 3705 communication processor, SNA Releases 4.1 and 4.2 will essentially bring SNA's network capabilities to parity with most commercial packet switching implementation by 1981.

At the terminal level, the SNA approach is markedly different from the packet approach. Most of today's packet-switching networks are primarily oriented to serving low speed asynchronous terminals. This is accomplished via protocol translation into a "network virtual terminal" standard. Synchronous terminal support has developed slowly

Most packet-switched networks will not support many types of synchronous terminals for several years

because of the wide variety of protocols in today's terminals. Under SNA, IBM imposes a single standard protocol, SDLC, at the terminal level and thus synchronous support under SNA for SDLC terminals is assured. However, support of other vendor terminals not compatible with SDLC will be impossible under SNA unless the user introduces interface devices capable of protocol conversion.

Most packet-switched networks will not be able to support many types of synchronous terminals for several years. With the new generation of packet switches, synchronous terminal support becomes a more straightforward programming problem and it can be expected that the introduction of capabilities for terminal support will be influenced by the population of each type of terminal in the marketplace. For example, in August 1979, Tymnet announced support of IBM 3270-type bisync terminals. With the advent of this capability, packet networks will provide more terminal access options than SNA since many link protocols could be supported in addition to SDLC, bisync, and start/stop. However, at approximately the same time that these capabilities emerge, microprocessor terminal interface devices should be readily available to map other major vendor link protocols into SDLC and thus allow direct interface of non-IBM devices into an SNA network.

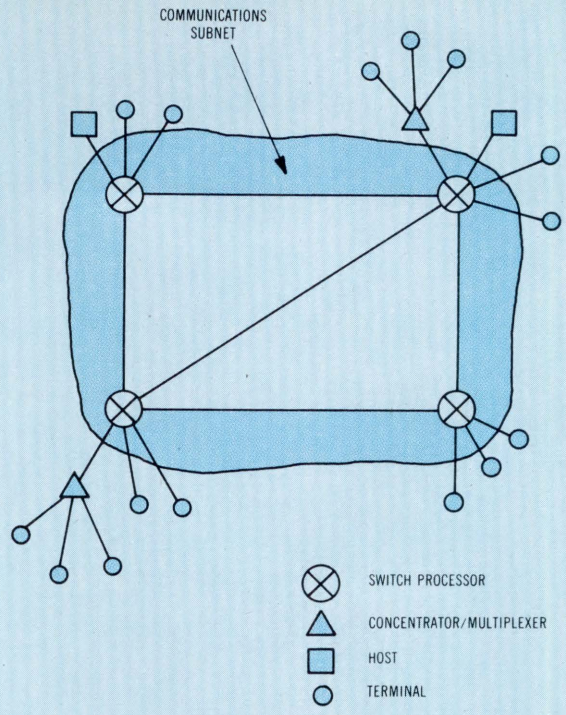
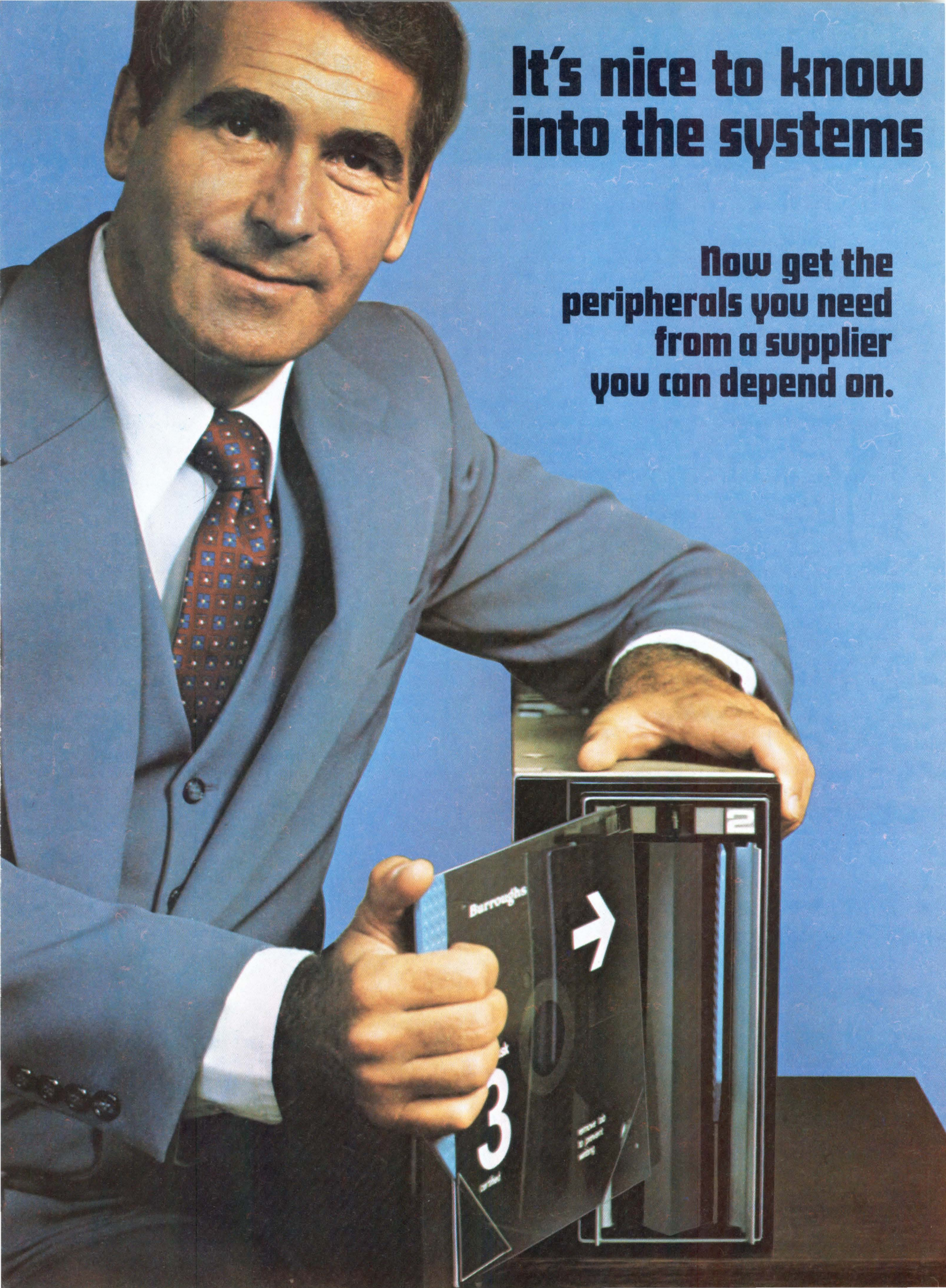


Fig 3 Packet-switched network architecture

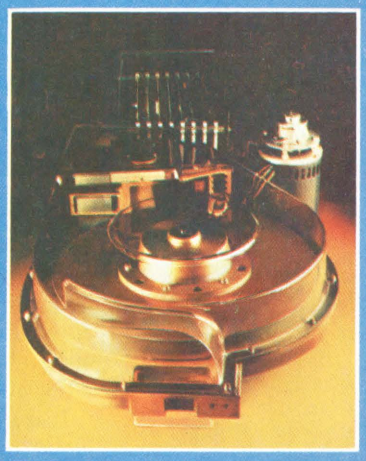
A major issue which has been developing over the last two years has been IBM's position on support of X.25, the widely adopted international protocol for interconnecting systems to packet networks. Because of the need to interface to the public packet networks in France and Canada, IBM has offered this support in these countries. Recently, IBM has been receiving growing pressure from their U.S. customers to offer this support domestically. The issues raised by providing such support are significant, since they allow users to configure IBM based systems around packet switched backbone networks. Moreover, if X.25 support is properly incorporated into an SNA network, the process of connecting non-IBM hosts to the network is facilitated. Thus, IBM support of X.25 has major ramifications in the area of combining SNA and packet network capabilities. Recently, IBM announced that it would provide worldwide support for X.21, the physical level of the X.25 protocol (X.25 is a 3-level protocol; X.21 is the first level). In addition, IBM is expected to

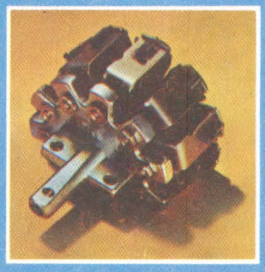

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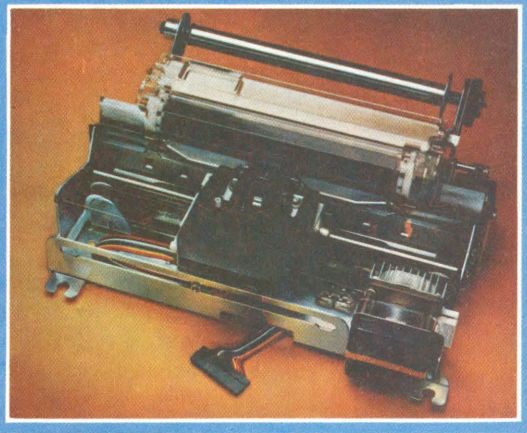
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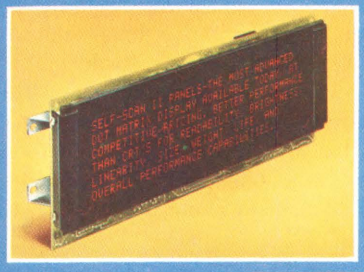
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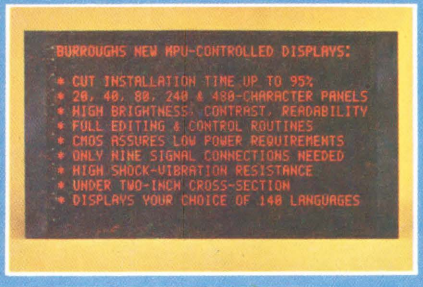
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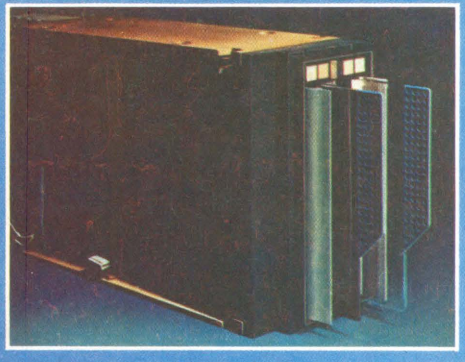














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announce its position on X.25 early in 1980. Based on its X.21 position, it appears reasonable to speculate that IBM will extend this support to X.25. History has shown, however, that speculation about IBM's future policy can be a hazardous game.

Existing packet-switched networks such as Telenet, Tymnet, Transpac, Datapac, and others are primarily public, multihost, multi-user networks. This trend to public networks occurred because of the original high cost of packet switches and the need to develop specialized software for each system. For example, packet switches originally cost $100,000 or more. They can now be purchased for approximately $25,000. On the other hand, all SNA networks appear to be private systems, containing just one or at most a few hosts.

Speculation about IBM's future policy can be a hazardous game

It is unlikely that SNA could be used cost-effectively in a major public network context within the next few years. Ultimately, if one accepts current projections, large hosts might indeed cost no more than today's packet switch. If so, SNA public networks could become both feasible and cost-effective.

At the same time, packet-switching networks are rapidly becoming more cost-effective for the private network environment. A number of major organizations are now seriously studying or have already begun implementing private packet networks. Within the next few years, this technology will have matured sufficiently to be viewed as a major alternative to SNA for private networks, even those containing only IBM hosts. Thus, it appears that from a network perspective, the SNA/packet-switching debate will end in a draw.

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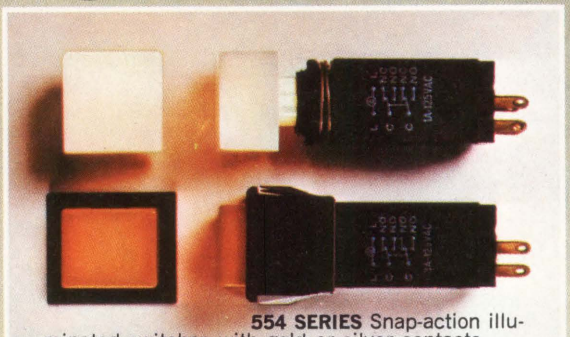
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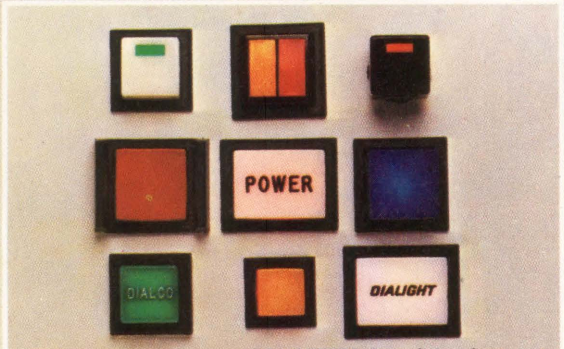
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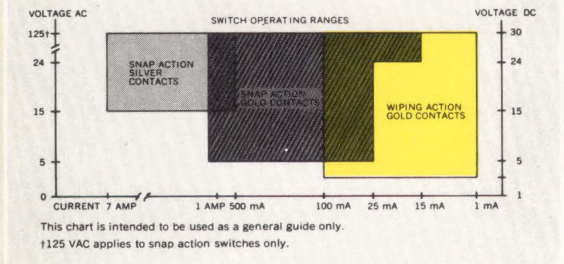
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Our new QD model has all of the features of our phenomenally popular SuperBrain with the addition of double-sided disk drives and an extra 32K of dynamic RAM. So, for only a modest increase in price, you can order your next SuperBrain with more than twice the disk and memory storage capability. But, best of all, the new QD model has the same tough, rugged construction and exceptional quality that made our SuperBrain such a success.



HOW DID WE DO IT?

The secret of SuperBrain QD's incredible disk storage lies within our new double-density double-sided disk drives. A total of nearly 720,000 bytes of data are formatted on two specially designed 5¼" drives. And that's more than enough to get you started with most serious small business applications. And SuperBrain QD's standard 64K of dynamic RAM will handle even the most complicated programming tasks.

Of course, if you're into megabytes instead of kilobytes, you may think neither SuperBrain is right for you. Not so! Intertec offers 20-96 megabytes of hard-disk storage which connects in seconds to either the SuperBrain or SuperBrain QD. So, your original investment is always protected. As you grow. No matter how much your needs expand.

BUT IS IT RELIABLE?

Our best salesmen are our present users. Not only have SuperBrain users been impressed with the inherent reliability of the system, they tell us that no other microcomputer system available today offers such a unique modular design concept. Just about the only tool required to easily maintain the system is a common screwdriver. And Intertec's total commitment to product service and customer support, with service outlets in most major cities, insures your original investment will be a valuable one for many years to come.

THE DECISION IS YOURS.

Whether your next SuperBrain is a regular model or our QD version, you will have the satisfaction of knowing you purchased what is becoming one of the world's most popular microcomputer systems. And regardless of which model you choose, you'll probably never outgrow it because you can keep expanding it.

So, call or write us today for more information. Intertec systems are distributed worldwide and may be available in your area now.

INTERTEC DATA SYSTEMS®

2300 Broad River Rd., Columbia, SC 29210
(803) 798-9100 TWX: 810-666-2115



*Registered trademark of Digital Research, Inc.

CIRCLE 13 ON INQUIRY CARD

ROUND TRIP 8-BIT B

OUR NEW 8-BIT ADC'S AND DAC'S GIVE YOU A GREAT ONE-WAY OR ROUND-TRIP PACKAGE, AT A PRICE THAT'S UNBELIEVABLE.

A-D
D-A

Now you can get in and out of your μP for the lowest fares in town.

Our AD7574 comes as low as $5 in 1000's, and offers specs and features you expect only from more expensive hybrids. Our AD7524 is priced even lower—$3 in 1000's. Take them together and you've got a complete, reliable A-D/D-A μP interface for only $8.

OUR AD7574 IS A HIGH PERFORMANCE 8-BIT ADC WITH SUPER SPEED, SUPER SPECS.

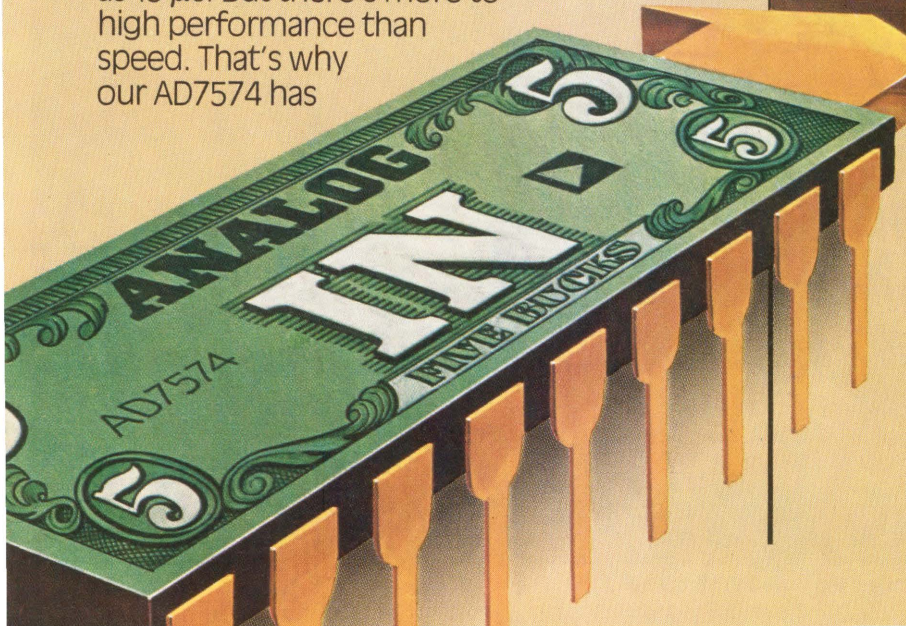
First, we're fast. We use the successive approximation technique to give you an accurate 8-bit A-D conversion in as little as 15 μs. But there's more to high performance than speed. That's why our AD7574 has its own internal comparator so you never have to fiddle with external components to get full 8-bit transfer accuracy. And our internal clock oscillator runs only during conversion for minimal power dissipation. In addition, the AD7574's small 18-pin DIP size, monolithic reliability, +5V supply, and the low power consumption inherent in CMOS make it perfect for applications in avionics, instrumentation and process automation.

DIRECT INTERFACE TO μP.

Our AD7574 has great handshaking ability for quick and easy μP interfacing. And all conversion operations are controlled by just two input signals, $\overline{CS}$ and $\overline{RD}$, available in every μP system.

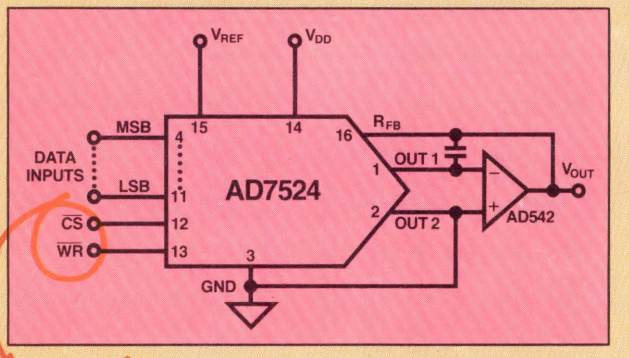
8080
DATA BUS

With its three-state logic outputs, the AD7574 allows easy connection to any μP data bus or system I/O port. And to make interfacing even easier, you can treat our AD7574 just like memory.



US FARES. $8. WOW!

OUR AD7524 IS AN 8-BIT DAC WITH LATCHES, AND ACCURACY TO ±1/8 LSB.



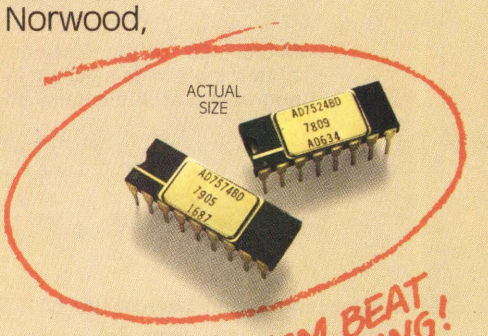
DIRECT CONNECTIONS TO YOUR μP'S CONTROL BUS!

We've taken one of our high performance 8-bit multiplying digital-to-analog converters and added level triggered latches – with on-chip control logic for extended interfacing capabilities. So our new AD7524 can be easily connected to nearly all 8-bit μP's, as well as I/O ports that provide latched data, without the need for supplementary circuitry.

Our AD7524 also features full four-quadrant multiplication so it can accept both negative and positive variable references – a big plus for applications in digitally controlled gain setting, signal control and attenuator circuitry. Other pluses with our AD7524 include advanced thin-film on CMOS fabrication for accuracy to ±⅛ LSB, single-chip construction for increased reliability, guaranteed monotonicity over the entire operating temperature range, +5V to +15V supply range, and a low 20 milliwatt power dissipation.

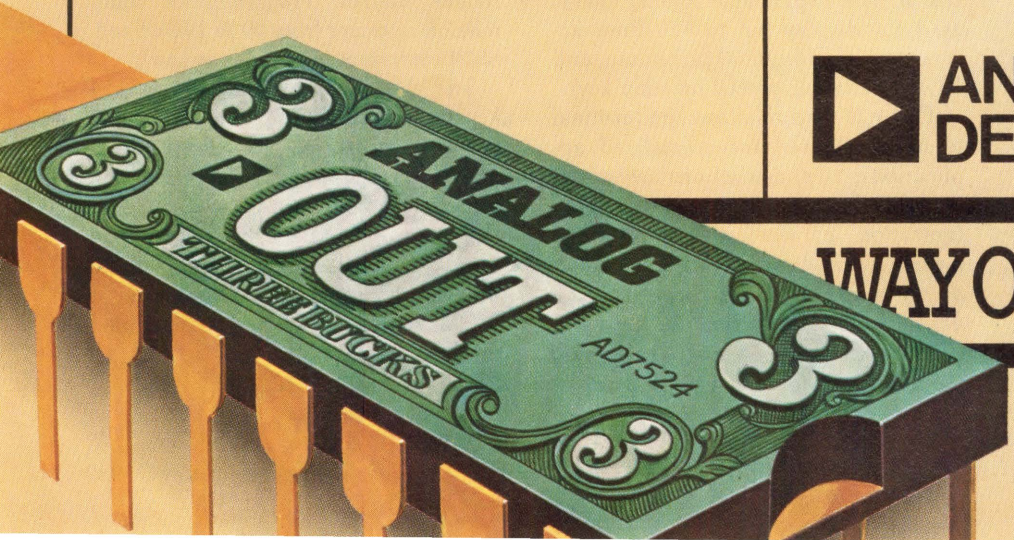
AND THE PRICE IS RIGHT!

Bus in with our AD7574. Bus out with our AD7524. Or go round-trip with both. No matter which way you go, you won't find better fares than Analog's. To get all the facts on these two exciting new full performance μP-compatible converters, call Doug Grant or Don Travers at (617) 935-5565. Or write Analog Devices, Inc., P.O. Box 280, Norwood, MA 02062.



WE'VE GOT 'EM BEAT COMING AND GOING!

ANALOG DEVICES

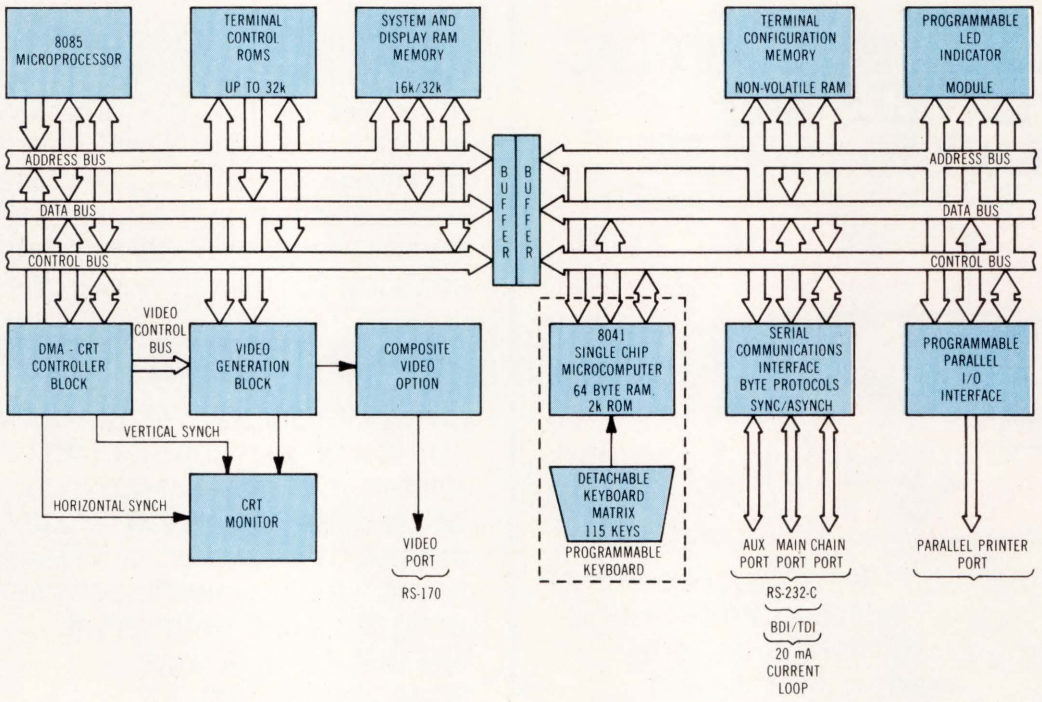


WAY OUT IN FRONT.

Analog Devices, Inc., Box 280, Norwood, MA 02062; East Coast: (617) 329-4700; Midwest: (312) 894-3300; West Coast: (714) 842-1717; Texas: (214) 231-5094; and representatives around the world.

CIRCLE 14 ON INQUIRY CARD

CRT Terminal Supports Special Protocols for Special Applications



Micro 4400 communications terminal. Device will operate in standalone or daisy chain cluster. Number of terminals in daisy chain is limited only by response time and maximum number of allowable terminal addresses. Multiple daisy chains may be dropped from single communications line

Microprocessor based Micro 4400 CRT data communications terminal is an extremely soft programmable device incorporating a terminal configuration manager (TCM), an intelligent menu-driven reconfigurator, to allow the user to tailor the terminal to a particular application. Requiring only limited operator interaction, TCM eliminates the need for jumper selection and hardware changeover typically needed in such reconfigurations.

The unit does not require a controller for emulation of Burroughs TD700/800 series terminals. For custom OEM applications, the 4400 can support special protocols conforming to special applications, and offers variations of known protocols. Printer control capabilities include support of both serial and parallel interfaces and also local and communications printers on a concurrent basis. Printer address may be shared or independent of the terminal group address in a polled environment. The terminal is offered by Beehive International, 4910 Amelia Earhart Dr, Box 25668, Salt Lake City, UT 84125. A basic unit is supplied with 16k of RAM, expandable to 32k. RAM is used for display (up to 120 lines accessed by scrolling), I/O print data, and 16 user-definable special function keys.

The TCM feature allows the terminal to be configured for specialized applications; TCM instructions are stored in nonvolatile EAROM so that configuration parameters are retained under power-down conditions. Commonly used entries or forms may be downloaded into the function keys and can be called up by a single keystroke, reducing both host computer processing and communication line loads.

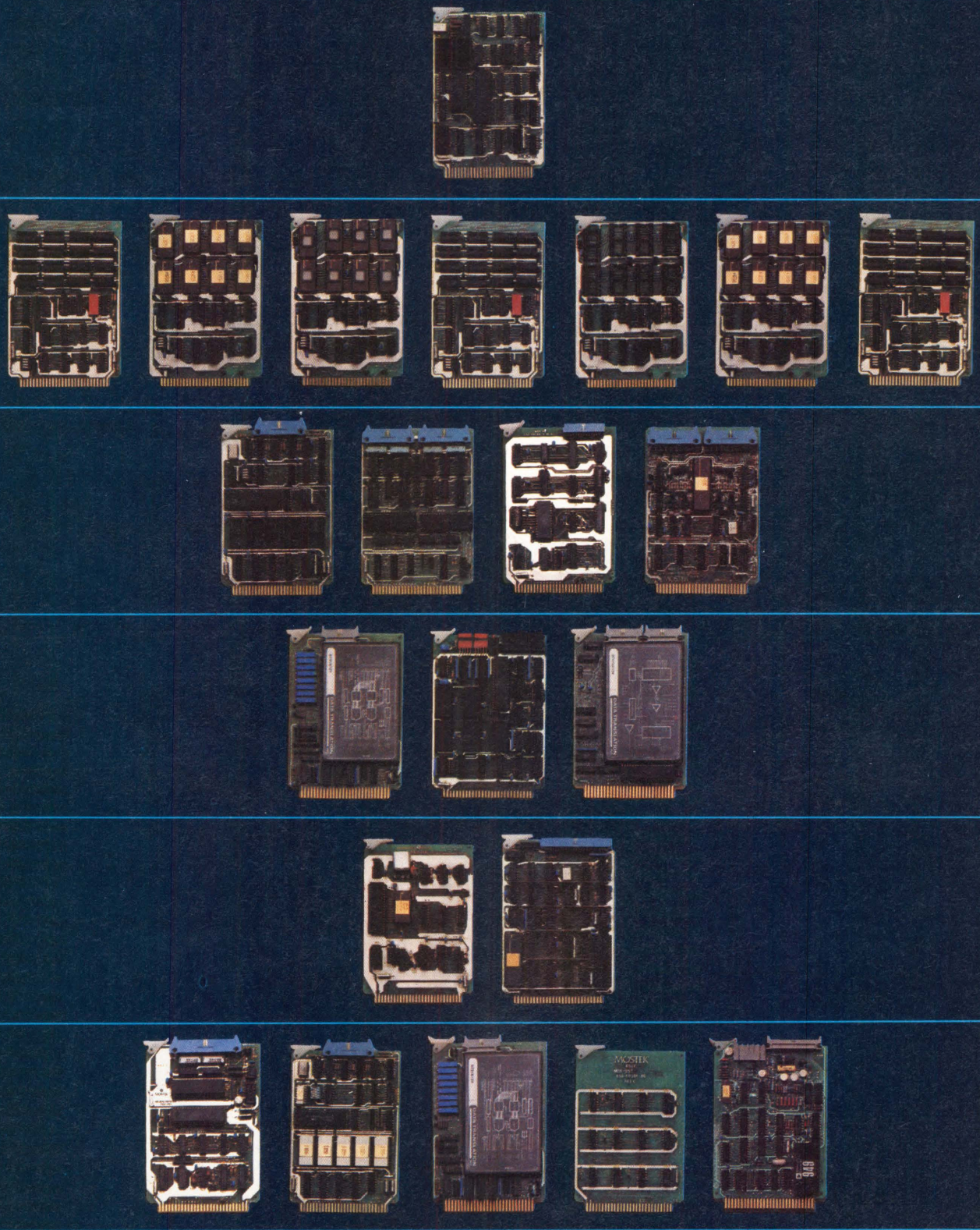
Display format is 24 lines x 80 characters. A 25th line is provided to display system status and operator messages. CRT screen is 12" (30.5 cm) diagonal measurement. Switch selectable communications interface handles serial RS-232-C, current loop, or Burroughs BDI/TDI. Programmable transmission rates are from 50 to 19.2k baud. ASCII communications code is used.

The detachable keyboard has 114 keystations, including numeric pad, cursor controls, edit keys, alpha lock, and the 16 function keys. A self-test function provides three levels of data and control loopback for isolation of terminal, local modem, and remote modem malfunctions. List price is $3295, with first deliveries scheduled for July 1980.

See at NCC Booth 1227

Circle 517 on Inquiry Card

Mostek MD Series.™
The solution to smart design: Buy only what you need.



Mostek's MD Series: Proven STD-Z80 BUS compatible cards simplify microcomputer design.

We're not alone. There are a number of OEM microcomputer board series to choose from. And like ours, each of them offers fully debugged hardware. Memory and I/O expansion modules. A/D and D/A interface. Software support systems. And more.

All of which reduces hardware development time. Eliminates wasted time writing hardware documentation. Enhances design momentum. Increases productivity. Profitability. And allows you to focus your resources on designing the right products for your markets. The bottom line? Using an OEM microcomputer board series is a very smart way to design.

So what makes the Mostek MD Series better? First of all, the MD Series is based on the powerful Z80 microprocessor. And all our MDX boards are STD-Z80 BUS expandable. So you can use any combination of MDX boards to configure your final system.

Then there's the small size of the boards themselves: a compact 4.5" x 6.5" that makes system packaging easier. And two speed versions to choose from: either 2.5 MHz or 4.0 MHz.

Mostek MD Series: Think of them as design tools you can buy one at a time.

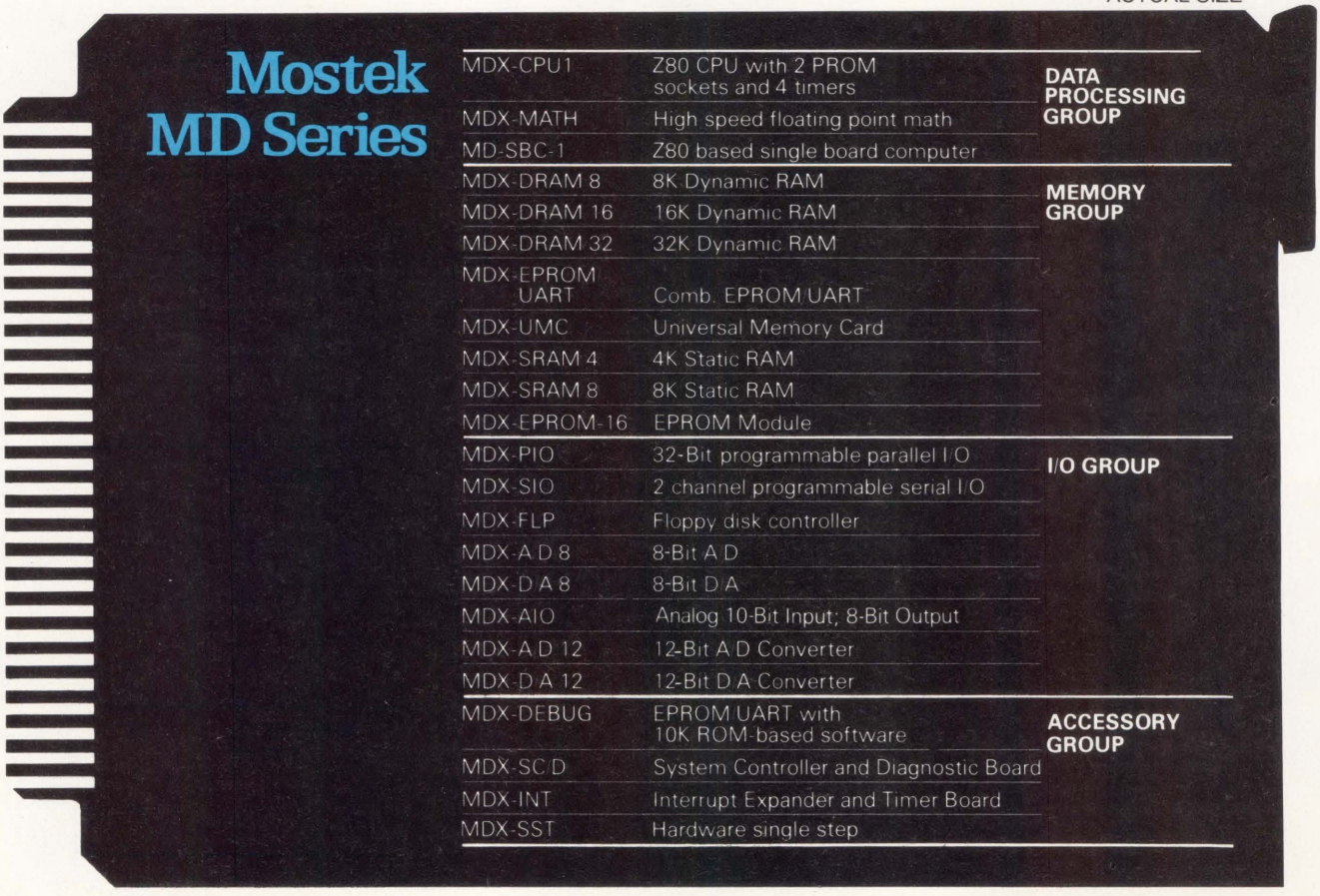
The strongest advantage of the Mostek MD Series is that it's designed like a set of compact precision tools. Each card has a singular specific function and can be bought separately. Yet all the cards work together because the STD-Z80 BUS uses a motherboard interconnect system.

These boards are further grouped into families to give you even more power and versatility. There's a data processing family, a memory family featuring dynamic and static RAMs, an I/O family that includes A/D and D/A modules, and powerful software development and accessories families.

So instead of having to buy the equivalent of large, multipurpose tools with more functions and more expense than your job requires, you select only those specific function tools that you need. At reduced cost.

Then, if you want to expand or modify your system, you simply add, delete, or change MDX cards in the card cage.

ACTUAL SIZE



MDX-CPU1	Z80 CPU with 2 PROM sockets and 4 timers	DATA PROCESSING GROUP
MDX-MATH	High speed floating point math	
MD-SBC-1	Z80 based single board computer	
MDX-DRAM 8	8K Dynamic RAM	MEMORY GROUP
MDX-DRAM 16	16K Dynamic RAM	
MDX-DRAM 32	32K Dynamic RAM	
MDX-EPROM UART	Comb. EPROM UART	
MDX-UMC	Universal Memory Card	
MDX-SRAM 4	4K Static RAM	
MDX-SRAM 8	8K Static RAM	
MDX-EPROM-16	EPROM Module	
MDX-PIO	32-Bit programmable parallel I/O	I/O GROUP
MDX-SIO	2 channel programmable serial I/O	
MDX-FLP	Floppy disk controller	
MDX-A D 8	8-Bit A D	
MDX-D A 8	8-Bit D A	
MDX-AIO	Analog 10-Bit Input; 8-Bit Output	
MDX-A D 12	12-Bit A D Converter	
MDX-D A 12	12-Bit D A Converter	
MDX-DEBUG	EPROM UART with 10K ROM-based software	ACCESSORY GROUP
MDX-SC D	System Controller and Diagnostic Board	
MDX-INT	Interrupt Expander and Timer Board	
MDX-SST	Hardware single step	

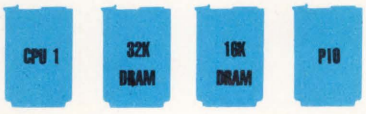
PROBLEM: A bank's main check processing system can capture and process millions of magnetically encoded checks. However, before the computer can process these checks the dollar amount must be magnetically encoded on each check, a slow and costly manual operation. In addition, checks are handled several more times for sorting and filing. Then mailed to the customer which also increases cost. Is there a better way?

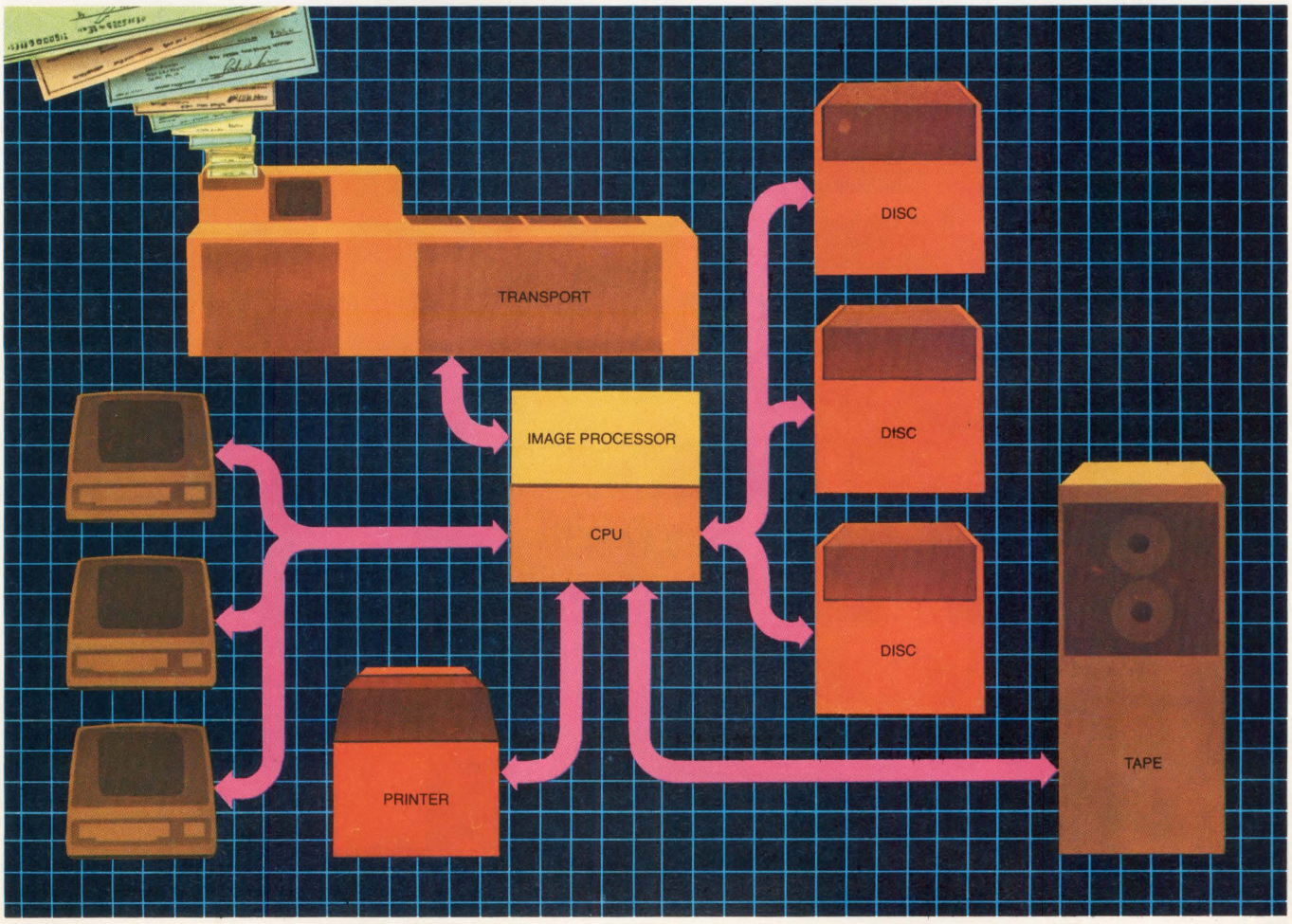
SOLUTION: A new image processing system developed by Dallas-based BancTec, Inc. This system handles a stored digital video image of the check instead of the check itself. The Image Processing System eliminates nearly all manual handling. It also eliminates returning checks to the bank's customers because it provides images of the checks on the customers' statements instead. The versatility of the system is enormous and the bottom line impact is increased efficiency with considerable time and cost savings.

According to Gene Dempster, principal software engineer, BancTec chose Mostek's MD Series because "they offer bite-size chunks that are versatile enough to perform many functions depending on where we use them in the system. They saved us from having to design a different piece of hardware for each function. Using one standard CPU board and one standard memory board, we reduced our inventory and made servicing cheaper."

"In addition, the Z80 (the microprocessor base for the MD Series) offers better string management instructions than any other microprocessor we saw. We estimate that we saved between four and six man-months by buying the Mostek boards off the shelf. As a result, we were able to bring the system to the market that much sooner."

There are four MD Series boards in the BancTec Image Processing System: The CPU 1, 32K DRAM, 16K DRAM and PIO. These are used in three separate areas of the system (transports, Fax terminals and image processor) to perform a variety of tasks.





PROBLEM: In many manufacturing processes, monitoring moisture content is critical, either in finished goods or in intermediate processing steps. Overdrying can waste raw materials and energy. Underdrying can result in costly reprocessing or outright product loss. What's needed is some method to measure moisture content within a very narrow range.

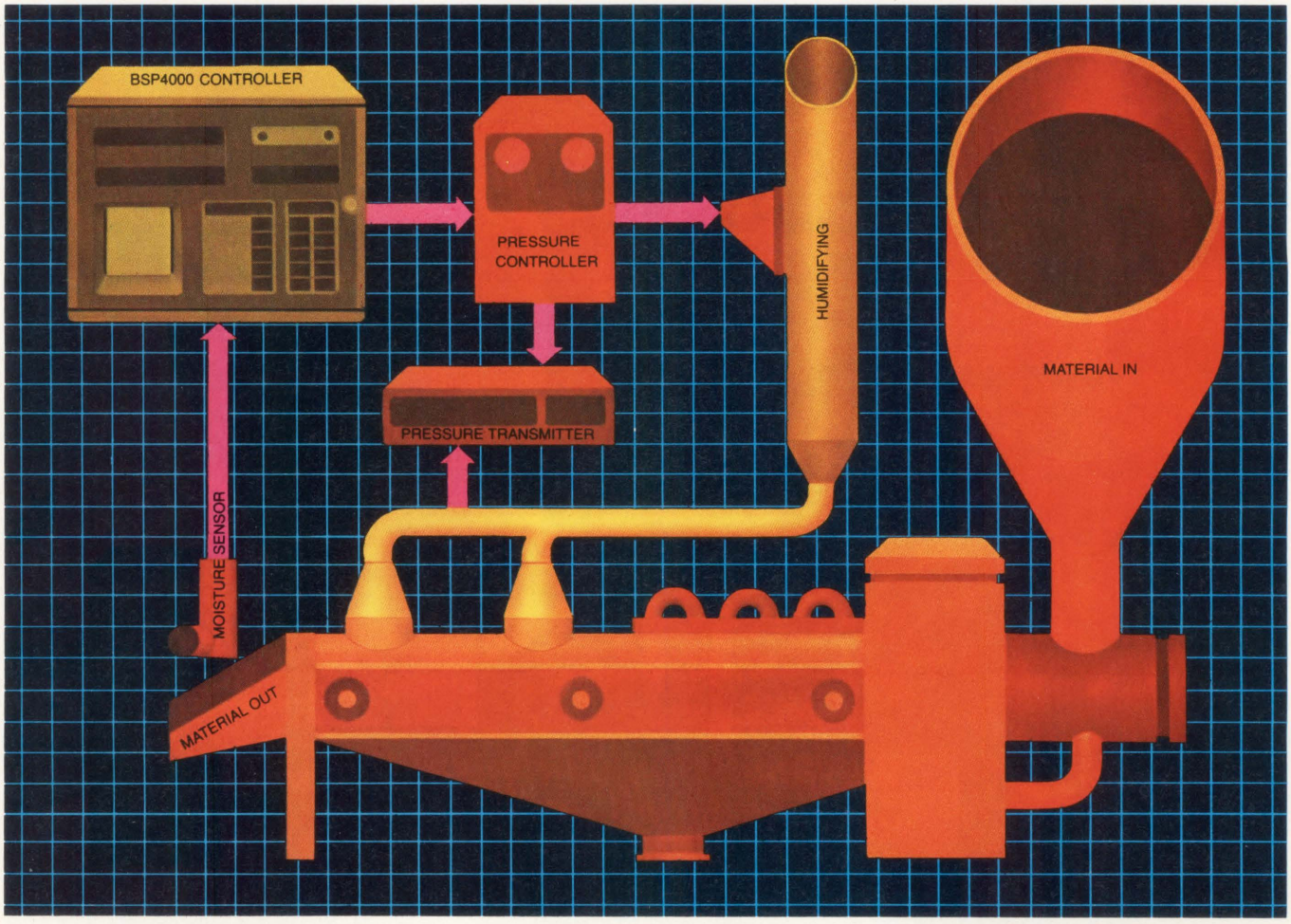
SOLUTION: The BSP 4000 Moisture Control System. Developed by the Moisture Register Company, this instrument monitors and controls moisture content on a continuous basis. It eliminates both underdrying and overdrying because it allows the user to enter calibration data and control parameters, and set minimum/maximum limits via keyboard or optical card reader, almost instantaneously.

In designing the BSP 4000, engineering manager and chief designer Charles Blevins aimed for a digital system with "smart formatting easily changeable by software."

"After a false start with another board family where the I/O needed wasn't available, we decided on Mostek's MD Series. The form factor became a real determinant; only Mostek had the compact, smaller-sized boards we needed. It was an excellent choice. Not only did the MD Series reduce our development time by at least 50%, it saved us money as well."

The Moisture Register BSP 4000 uses five Mostek MD Series boards: the CPU 1, 2 PIO boards and 2 EPROM/UART boards. These handle all the product's data transmission chores, along with D/A and A/D conversion.





PROBLEM: Granted, the MD Series boards can virtually eliminate hardware development time. But what about time-intensive software development?

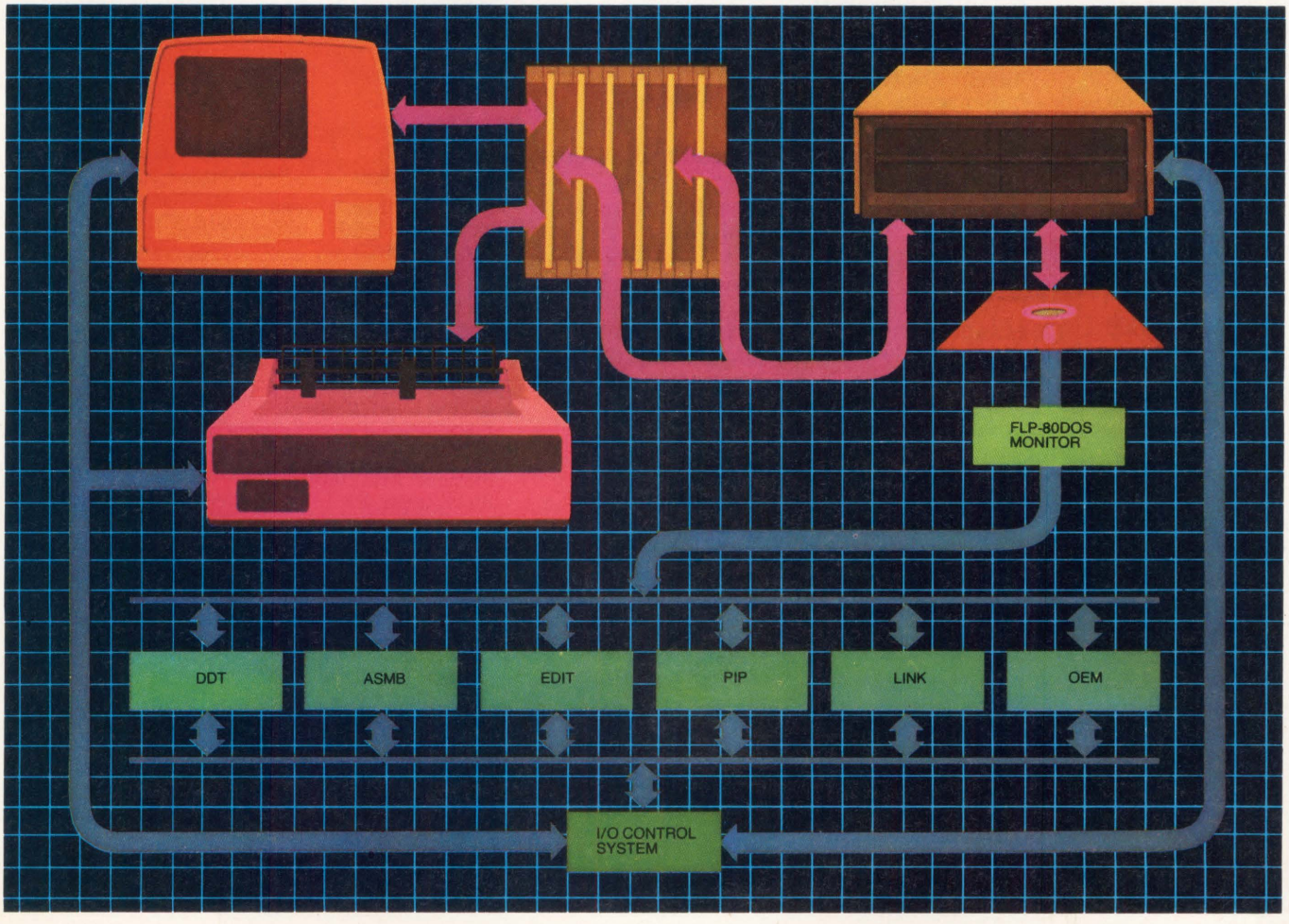
SOLUTION: Mostek's MD Series Software development systems. Seven different models are available, including Mostek's powerful Matrix™ dual floppy disk-based computer. You can buy as little or as much as you want, depending on your needs. High level languages include BASIC and FORTRAN.

Or you can build your own software development system using MD Series cards. By supplying the equipment you have, like CRT's and line printers, you can cost effectively tailor a system to your budget. Plus you can reuse the MDX cards from the development system once the software task is accomplished.

To configure a typical development system from MD cards, you need an MDX-CPU 1, two MDX-DRAM32s, MDX-FLP, MDX-EPROM/UART, wirewrap boards, cables, and a PROM programmer. Plug the cards into a MDX-card cage with power. Connect the system to your CRT, line printer and floppy disk drives (the MDX-FLP controls up to four single-sided drives). Purchase Mostek's FLP-80DOS disk-operating system, and insert those diskettes into two drives. You now have one of the industry's most powerful software development systems.

Mostek also has complete diagnostic software to give you even more flexibility. MEDEX 80 troubleshoots your system to the board level. MITE-80 enables your MDX system to execute multiple programs. And supplementing MITE-80 is BIOS, a selection of routines to help you design I/O drivers.





Mostek MD Series: All the tools for a smart design.

Before you define your next design path, consider the expandable, tool-like approach of the Mostek MD Series. For both hardware and software needs, it minimizes front-end investment. And then, enables you to respond economically and quickly to changing product definition and/or market conditions. For the 1980s, it's the smart way to design.

For more information, contact your nearest Mostek distributor listed below. Or call or write Mostek, 1215 W. Crosby Road, Carrollton, TX 75006. (214) 323-6000. In Europe, call Mostek Brussels, 660.69.24.

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Public Packet Network Offers Second Generation Electronic Mail Service

OnTyme-II, an enhanced version of its electronic mail service that has been in use for the past several years, has been announced by Tymnet, Inc, 20665 Valley Green Dr, Cupertino, CA 95014. Key feature of the service is the ability to provide direct communications from ASCII terminals to facsimile (fax) terminals for hard copy output. The system supports any combination of virtually all makes and models of terminals, including IBM 3270-compatible devices, dial-in, dial-out, and TWX.

OnTyme-II runs in a partition of the internally switched interface system (ISIS) software operating system on the Tymnet "Engine" communications node processor. ISIS allows new systems to be added without need for hardware or software changes.

The service has been implemented in concurrent PASCAL high level user-oriented language, allowing the system to be tailored to particular requirements. As much word processing capability as needed can also be incorporated.

Direct communication with fax terminals is enabled by an ASCII to fax translator (AFT), a communications device developed by Compression Labs, Inc, 10440 N Tantau Ave, Cupertino, CA 95014. AFT accepts serial ASCII data at its input port, automatically dials out the number of the destination fax machine, and translates the ASCII character coded text to fax image, for both automatic and manual machines. Both Group I (4 to 6 min/page) and Group II (2 to 3 min/page) machines can be accommodated. A code at the end of the message stops transmission to prevent reproduction of blank space and avoids unnecessary line usage. OnTime-II terminals will input text to the AFT machines in the network via RS-232-C interfaces at rates up to 9600 bits/s.

OnTyme-II will be available beginning June 1. The service is scheduled to provide full fax to fax message switching later this year.

Circle 518 on Inquiry Card

How to Improve Your Image



The Problem: Glare. And poor image-to-background contrast. They wash out displayed information, cutting operator efficiency and lowering productivity.

The Solution: OCLI Contrast Enhancement. It reduces glare by 17 to 1 over untreated glass. It's working now for some of the biggest names in display technology, including IBM, Four-Phase and Tektronix. Write us. We'll explain how it can work for you.

I'd like to improve my image.

Tell me more about OCLI Contrast Enhancement for CRTs.

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OCLI

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P.O. Box 1599, Santa Rosa, CA 95402
TWX (510) 744-2083 Telephone (707) 545-6440

CD-80

Introducing STARPLEX™ with ISE™.

The fully developed development system.



We've done it.

We've created an easy-to-use development tool that helps design engineers do their whole job on the STARPLEX development system.

STARPLEX can not only develop software for 8080, 8048, 8049, 8050, 8070, NSC800, 8085, Z-80 microprocessors and BLC/SBC Series 80 boards, but now with ISE (in-system-emulation) you can also test, analyze and debug prototype hardware/software for the same products.

On ISE. The ISE module is a separate unit incorporating its own CPU, 32K bytes of user programmable memory and all the necessary logic for breakpoints, tracing and memory mapping. The characteristics of each microprocessor to be emulated are built into individual "personality" cards that share the logic resources of the entire ISE system. All you have to do to emulate a different microprocessor is install the appropriate personality card. So you save both time and money.

And our ISE lets you run two of the same or different microprocessor target cards simultaneously so for the first time you can have real-time emulation or debugging in a multiprocessor environment.

Better yet, since ISE does not share the STARPLEX BUS, the system does not have to compete for memory access with its host. So ISE is the only development tool available that offers real-time emulation with 32K real-time map memory.

That means your program runs in real time exactly as it would on your developed hardware. And this emulation/debugging is possible before you even have a hardware prototype.

There's ISE and there's ISE. In-system-emulation is not unique to National, but there are convenience features in our ISE which are not available from any other source.



Our symbolic debugging capability provides not only the usual breakpoint conditions, but also a "coast" command which allows you to continue executing a program after the breakpoint combination has been satisfied.

Our easy-to-understand ISE software comes completely integrated into the STARPLEX system. That includes our unique Automatic Testing or In-File capability. In-File is an automatic testing mode that will implement a predefined sequence of tests. ISE can also record those results to show exactly how each part of the system performs during the tests.

Our special Archive command lets you interrupt a debug session and save your system status on diskette. Using our Restore command you can read it back at a later time and start up where you left off.

Look into our ISE. The ISE 8080 has all the unique National features mentioned above including: real-time mapped memory, multi-processor emulation, In-File, and flexible breakpoints with coast.

ISE 8048 has the 8080 features plus the ability to read and disassemble internal ROM; make patches in assembly code; support 11 MHz components; support the entire 8048 family; and use prototype crystal clocks.

The Z-80 ISE is a bus-compatible board that plugs directly into STARPLEX. It can support 2-4 MHz Z-80s; provide 4 tracing options; supply relational and regional breakpoints; and provide refresh for prototype memories.

With one stroke from STARPLEX. ISE functions with one key stroke from the STARPLEX system keyboard.



The entire development system works right along with the operator clarifying procedures with a menu of command options, a series of fill-in-the-blanks, error messages in English, and even a HELP key to call up ISE software function information for review. Programmers can sit down and operate the STARPLEX system in minutes without wading through a manual.

During the emulation process a portion of the STARPLEX screen is reserved to display status information including the type of microprocessor being emulated, the state of the emulated microprocessor(s), breakpoint condition masks and whether or not breakpoints are enabled.

Room for the future. The STARPLEX development system is just one way we're ready for the future at National. We've built STARPLEX so there's room for additional boards, making the system fully expandable.

And we've planned a great future at National. We're a growing, $1 billion company providing the security of the longest board warranty in the business and guaranteed 48 hour exchange service.

But we've saved the best thing about STARPLEX with ISE for last.

You won't have to wait for the future to realize the economical advantage to you with a STARPLEX development system. Although STARPLEX with ISE offers features not found in any other development system and provides cost saving benefits in both time and money, it costs substantially less to own and operate than any competitive system.

When you get down to it, that's a real development in development systems.

For more information on STARPLEX call us at National Semiconductor, (800) 538-1866; (800) 672-1811 in California.

For more information on STARPLEX with ISE write to us at Microcomputer Systems, National Semiconductor Corporation, Mail Stop 16250, 2900 Semiconductor Drive, Santa Clara, CA 95051.

Name_____ Title_____

Company_____

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Application_____

National Semiconductor
The Practical Wizards of Silicon Valley

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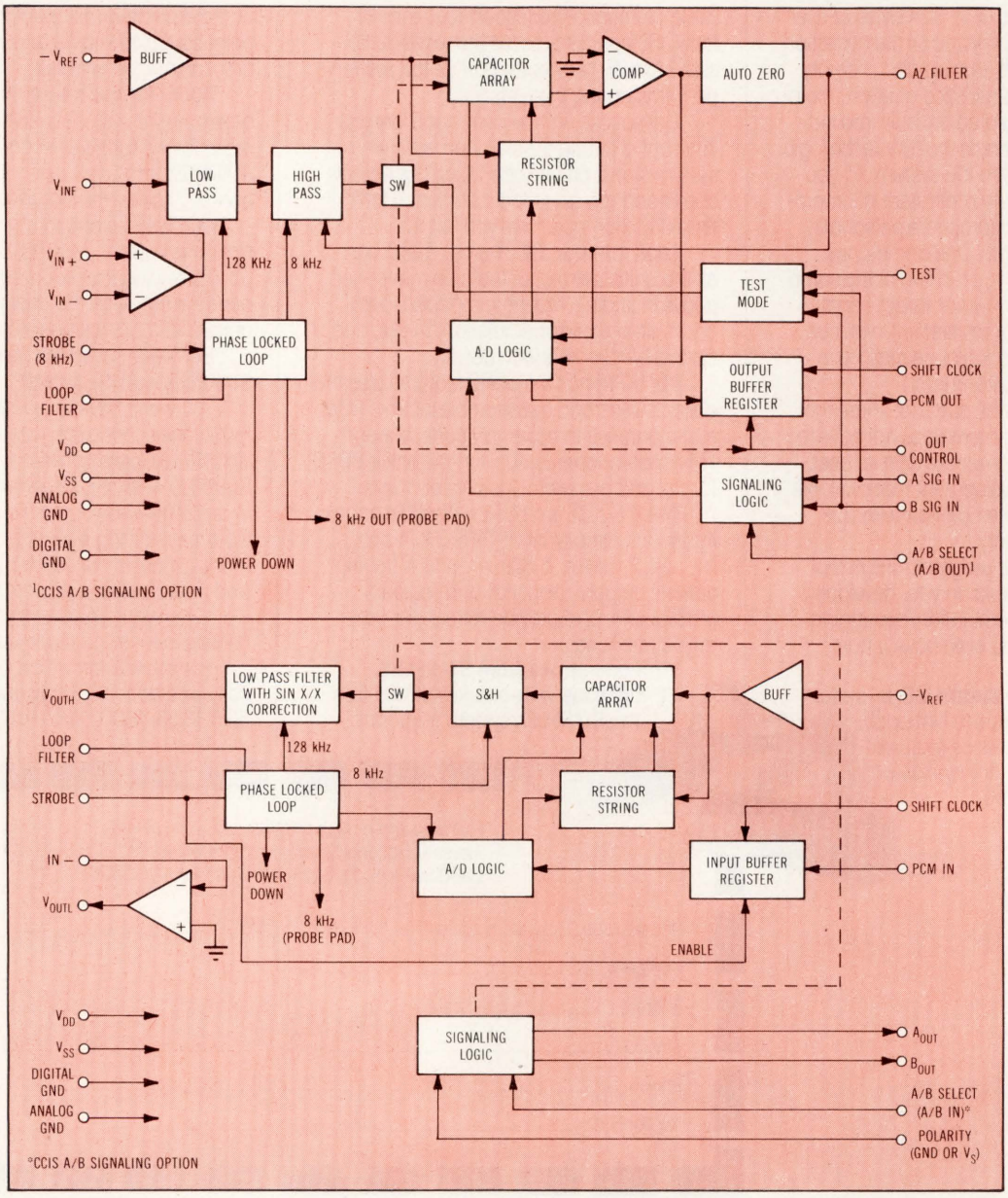
CIRCLE 16 ON INQUIRY CARD

μ-Law Codec Set Embodies Filters on Each Chip

Partitioned as encoder/filter on one chip and decoder/filter on the other, S3501 encoder and S3502 decoder form a companding set to implement a per channel voice frequency coding conversion for PCM channel banks and PABX systems requiring the μ-255 law transfer characteristic. American Microsystems, Inc, 3800 Homestead Rd, Santa Clara, CA 95051 says that the set meets or exceeds the AT&T D3 and CCITT G.711 and G.733 specification.

Transmission and reception rates of 8-bit data words containing analog information can be arbitrary up to 3.2M bits/s, with analog sampling at a nominal 8-kHz rate. Both chips generate all internal timing signals in a phase lock loop (PLL) that uses an externally supplied 8-kHz strobe signal.

The 18-pin S3501 encoder chip incorporates a bandpass filter with D3 filter characteristics. The fifth order low pass band limiting filter is followed by a Chebyshev high pass filter. Loss of at least 25 dB at 65 Hz helps minimize power frequency-induced

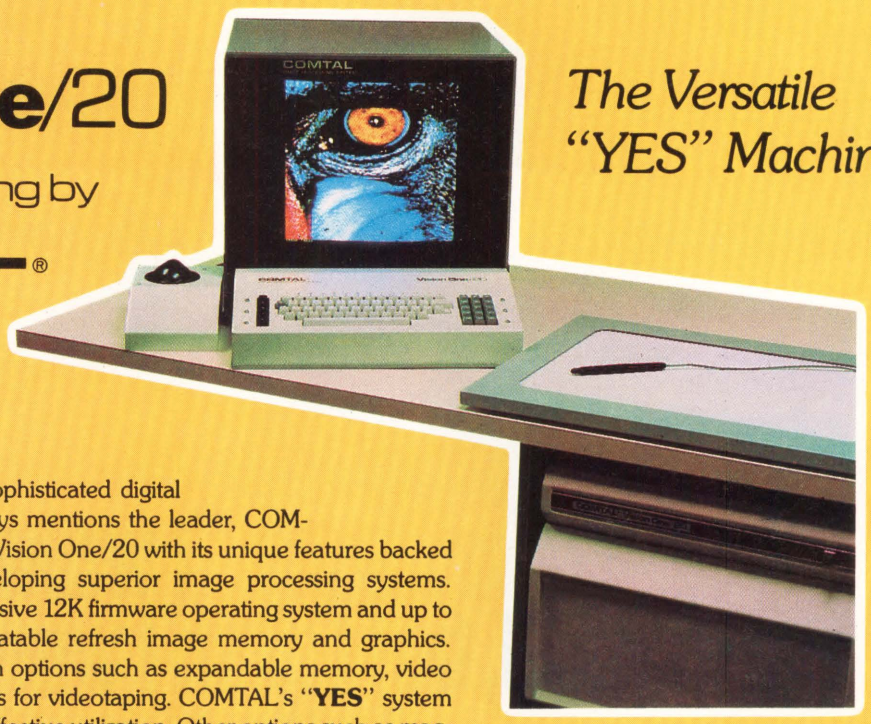


Encoder with filter (top) and decoder with filter. Transmission and reception of 8-bit data words containing analog information is performed at 1.544M-bit/s rate with analog sampling at 8-kHz rate. Strobe input synchronizes transmission and reception of time multiplexed PCM information of several channels over single transmission line

Vision One/20

image processing by
COMTAL®

The Versatile "YES" Machine



Professional talk about the most sophisticated digital image exploitation equipment always mentions the leader, COMTAL. ☐ **YES**, and that includes the Vision One/20 with its unique features backed by the experience gained in developing superior image processing systems. ☐ **YES**, Vision One/20 has an exclusive 12K firmware operating system and up to 48 megabytes of dynamically allocatable refresh image memory and graphics. ☐ **YES**, field upgradeability through options such as expandable memory, video input and output, as well as TV rates for videotaping. COMTAL's "**YES**" system requires a minimum of training for effective utilization. Other options such as magnetic tape and disc storage are available. Specialized image processing hardware is available for image arithmetic combination, convolution, Landsat classification, plus small area color correction, and all function in real-time, in 1/30 second. ☐ **YES**, all this—in a system that can accommodate future growth as application requirements expand. Multiple user capability, up to 4 work stations, offers resource sharing. ☐ **YES**, with COMTAL's leadership pacing the state-of-the-art, it adds up to flexibility now—and flexibility later. ☐ **YES**, Vision One/20 image processing systems have dual-ported random access memories starting at 512x512 pixels at multiples of 4 bits of brightness depth, with growth up to 4096x4096-24 bit pixels. ☐ **YES**, random access refresh memories are constantly growing in size and shrinking in cost. Digital image rotation is a reality now. ☐ **YES**, a 24 bit x 24 bit color computer is available for image composition, as is independent arbitrarily shaped small area processing capability in monochrome and color. There's high resolution digital stereo and instantaneous—1/30th second—convolution for filtering. Or, bigger filters exist by recursively iterating and updating kernels 30 times/sec. ☐ **YES**, Vision One/20 provides stand-alone full feature image processing as well as the ability to interface to numerous host computers. ☐ **YES**, dynamic refresh memory partitioning allows for different applications. ☐ **YES**, real-time roaming, with window sizes 512x512 pixels or larger, through the data base, as well as 2X and 4X zooming and 3x3 convolution at 70 MIPS—all implementable in real-time. Ask about the future of image processing from the company with renowned research experts, hardware experts, firmware experts and software experts. COMTAL's field service offices on the East and West coasts are there to help users. ☐ **YES**, successful sales representation worldwide as COMTAL triples its present production capacity in new facilities.



Is all this expensive? ☐ **NO**.....We invite your inquiries—and ☐ **YES**, we have the answers.

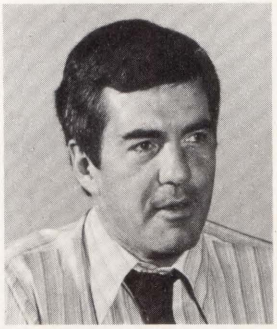
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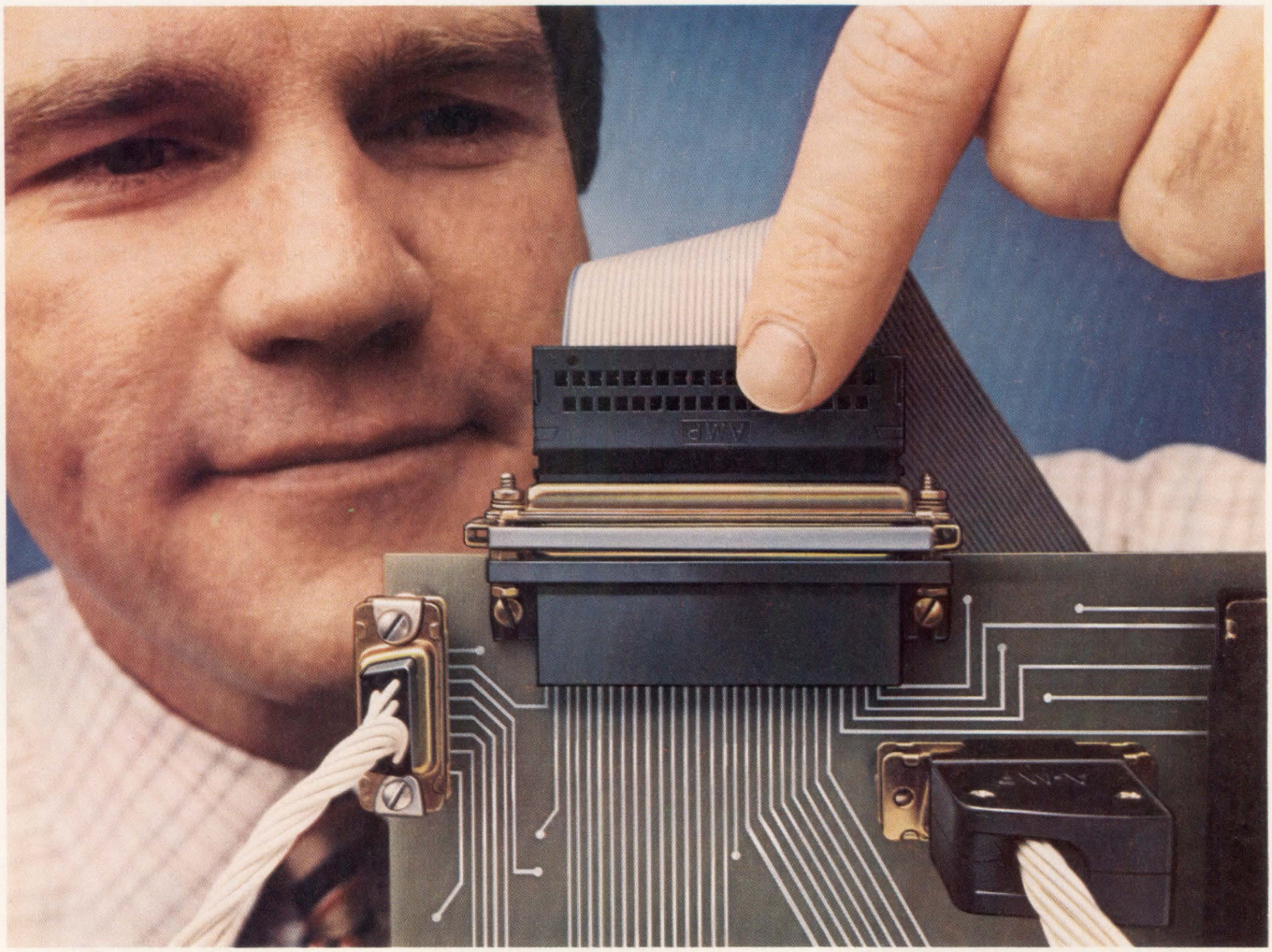
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CIRCLE 17 ON INQUIRY CARD



"I wanted to filter out EMI, but I didn't want to redesign. AMP showed me the way."



A better way. With AMP filtered pin headers, connectors and interfaces.

High performance Quiet Line Filters have been incorporated into an integral filter/contact design, and preassembled in popular, industry-standard connector configurations. Which means a simple retrofit can solve your interference problems, without extensive circuit redesign. And they can assist you in complying with the emission limitation requirements of VDE and the FCC.

AMP low pass filters operate on a unique principle. Unlike other filters, they're absorptive so instead of reflecting EMI and noise back into the system, they dissipate it harmlessly as a small amount of heat.

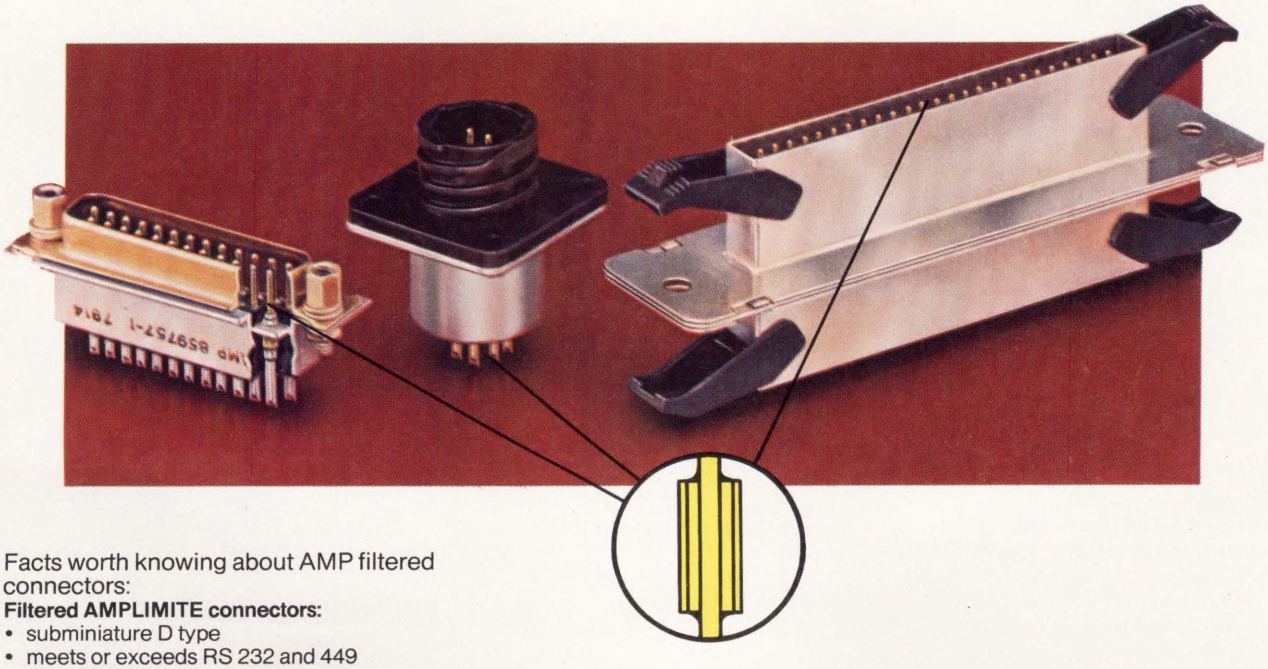
They also have no internal resonance, are insensitive to load and source impedance variations, and have high insertion loss ratings—features that combine to give you the highest performance possible.

And you're assured of a variety of application options. Feedthrough pin headers for example, are bulkhead mountable and intermateable with AMP-LATCH and AMPMODU receptacles, as well as other .100" centerline types.

For data communications specifications RS 232 and 449, AMPLIMITE subminiature D headers are board mountable, and both they and a similar filtered interface style intermate with all similar types. Circular configurations are also available.

This combination of connectors, headers, interfaces, and high performance filters is unique in the industry. And together they work for you. Because while our filters eliminate interference, our connectors eliminate the need for redesign.

AMP has a better way.



Facts worth knowing about AMP filtered connectors:

Filtered AMPLIMITE connectors:

- subminiature D type
- meets or exceeds RS 232 and 449
- mates with MILC 24308 connectors
- available in 9, 15, 25, and 37 position sizes
- supplied in right angle board mount and solder cup versions, or as a male/female interface for easy field retrofit.

Filtered pin header:

- 40 and 50 positions .100" centerline, double row configuration
- intermateable with AMPMODU and AMP-LATCH Connectors, as well as all existing similar types.
- bulkhead mountable

Circular connector:

- 8 position
- bulkhead feed-through receptacle with pin contacts

Where to call: For more information call the Filtered Connector Information Desk at (717) 780-8400.
Where to write: AMP Incorporated, Harrisburg, PA 17105.

AMP, AMPLIMITE, AMPMODU, and AMP-LATCH are trademarks of AMP Incorporated.

AMP

CIRCLE 18 ON INQUIRY CARD

Hazeltine

The reliability we take to sea...



is echoed on dry land.

The Hazeltine sonobuoy is a marvel of reliability and performance in a low-cost package. After surviving a drop from an airplane, it deploys itself beneath the surface of the ocean, and uses sophisticated electronics to detect and locate submarines. Since sonobuoys aren't recovered at the end of the mission, their cost has to be low.

These same qualities make the Hazeltine 1420 conversational terminal a marvel of EDP display equipment. It's so reliable, in any environment, that we are able to warranty it for two full years, the longest "no-cost" warranty in the terminal industry. Yet it costs less than other terminals with similar performance and capabilities.

You won't be dropping your terminals from airplanes or using them underwater. But won't reliability, performance and low cost be important to your business in the eighties?



Hazeltine Corporation, Greenlawn, New York 11740 (516) 549-8800

Hazeltine and the Pursuit of Excellence

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Hazeltine **Answers for the eighties**

CIRCLE 19 ON INQUIRY CARD

noise effects. The ADC uses a binary ratioed capacitor array and linear resistor string based on charge redistribution techniques to perform A-D conversion with μ-255 law transfer characteristics. Timing signals for the bandpass filter (128 kHz and 8 kHz) and the ADC (1.024 MHz) are generated by a PLL which comprises a voltage controlled oscillator, frequency divider, loop filter, and lock detector. The PLL locks to the externally supplied 8-kHz strobe. A dual speed autozero circuit eliminates long term system drift errors and need for trimming, and an uncommitted op amp provides gain trimming and antialiasing. Control logic provides for D3 signaling and in "A" versions for common channel interoffice signaling (CCIS).

The 16-pin S3502 decoder comprises a DAC, sixth order elliptic low pass filter with sin X/X correction, a PLL for timing signals, and control logic for CCIS and D3 signaling. A low impedance op amp provides direct drive of a 600-Ω load and optional TTL or relay drive.

Both chips typically require power of 5 and −5 Vdc, and a reference of −3 V. Both chips also provide power-down in the absence of the 8-kHz strobe. If their PPLs sense an unlocked condition, the chips are automatically forced into the power-down mode to minimize power dissipation. Standby power dissipation is 15 mW/chip. Typical operating power dissipation for the S3501 is 70 mW, and for the S3502, 55 mW.

Pricing per set for quantities of 100 in ceramic DIPs is $37.50 (North America).

Circle 519 on Inquiry Card

Fiber Optics License And Technology Agreement Signed

Manufacturing rights to double-crucible production methods for low loss, high bandwidth optical communication fiber and cable are included in an agreement recently signed by Galileo Electro-Optics Corp, Galileo Park, Sturbridge, MA 01518, and the British Post Office (BPO). The advanced production process produces fibers which have achieved losses of less than 4 dB/km, numerical apertures (NAs) greater than 0.5, and bandwidths of 1 GHz/km.

According to Galileo spokespersons, the new process allows production of small core, low NA, low loss fibers suitable for long haul telecommunications applications as readily as large core, high NA fibers for short haul data links. The double-crucible draw is also

DESIGNING A SYSTEM THAT REQUIRES A PRINTER?

Think Fixed Head Thermal

Mechanical printers? They're too noisy, too expensive, they cost too much to maintain. And they're not nearly as reliable as GULTON'S fixed head thermal printers with only one moving part, no ink system, ribbon mechanism, hammer or moving head problems. No RFI, either. And we make our own printheads for added reliability.

Whatever your requirements . . . numeric, alphanumeric or printer/plotter, GULTON printers interface easily with your microprocessor or BCD data sources.

So, if you're designing a system that requires a printer, think fixed head thermal . . . think GULTON.

Also from GULTON: O.E.M. Recorders; Techni-rite Oscillographic Chart Recorders; Rustrak Trend and Event Recorders and West Temperature Controls.

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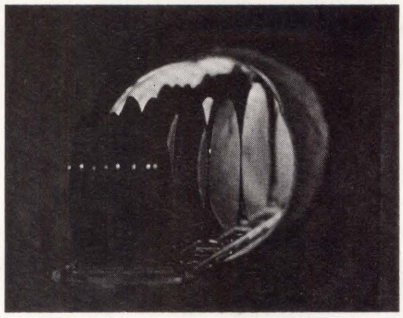
CIRCLE 20 ON INQUIRY CARD

Bipolar is our business.

And our future.

MMI is committed to designing and delivering the bipolar product you want. In volume. On time.

Continued leadership in bipolar technology.



MMI has grown to become a $65 million company by consistently designing and delivering state-of-the-art bipolar LSI products. And now we're growing faster than ever.

Our tradition of excellence began with the industry's first 1K PROM in 1971. This was followed by the first 2K, 4K and 8K bipolar PROMs, by the first fast 8x8 multiplier, and then the 15 MHz FIFO. Our latest innovation is PAL™ programmable array logic, the LSI circuit which allows you to program your own logic on a chip.

And we'll continue the tradition, working hard in the future to develop products which are denser, faster and more economical . . . the products you want!

Delivery that keeps pace with our designs.

MMI has made a commitment to deliver large volumes of bipolar products. We currently ship—and will continue to ship—more bipolar PROMs than anyone else in the world.

Our annual output has tripled during the last twelve months. MMI was the first to install a 4-inch bipolar wafer fab line. And we will expand that line's capacity by another 80% before the end of 1980. At the same time, we have begun converting our 3-inch line to 4 inches and will double its output by mid-1981. We have also broken ground on a new assembly facility and expect it to be operational by September of this year. Over the next few years we'll spend 15-20% of every sales dollar on facilities and equipment to assure you volume delivery of MMI's bipolar LSI.

Let us prove it.

Send for a specially prepared report which details MMI's engineering and production capability and outlines our extensive line of digital bipolar LSI products. Please address your requests to Applications Department, Monolithic Memories, Inc., 1165 E. Arques Ave., Sunnyvale, California 94086.

Monolithic Memories MMI

CIRCLE 21 ON INQUIRY CARD

said to be the only continuous process for making low loss fibers, and is practical for producing fibers in lengths exceeding 25 km. This avoids splicing every 1 or 2 km to make longer cables with fibers produced by conventional methods, and eliminates the attenuation introduced by such splices.

Preliminary plans are to produce the specially formulated glass raw materials in the company's Sturbridge plant, and draw the fibers by the double-crucible method at its subsidiary Galite, Inc, in Wallingford, Conn. Volume production of the new cables is expected within 6 to 9 months. The company says some select samples for prototype evaluation will be available within weeks.

Circle 520 on Inquiry Card



MOS/LSI Controller Circuit Handles Most Line Protocols

General purpose MOS/LSI communications protocol controller circuit F6856 provides compatibility between most line control protocols used in data communications terminals, controllers, and computers. The chip, from Fairchild Camera and Instrument Corp, MOS Products Group, 101 Bernal Rd, San Jose, CA 95119, has both bit- and byte-oriented protocol capability, including complete Bisync protocol processing. It handles such popular line protocols as SDLC, HDLC, ADCCP, Bisync, and DDCMP.

Four 16-bit addressable registers can be user programmed to specify the desired protocol as well as options within it, and the device performs the bulk of the required processing. This removes virtually all of the line control overhead tasks from the processor and computer. Contents of the registers can be altered online to change protocols, achieving compatibility between different protocols. The device can interface with most microprocessors, microcomputers, and minicomputers with either 8- or 16-bit data buses.

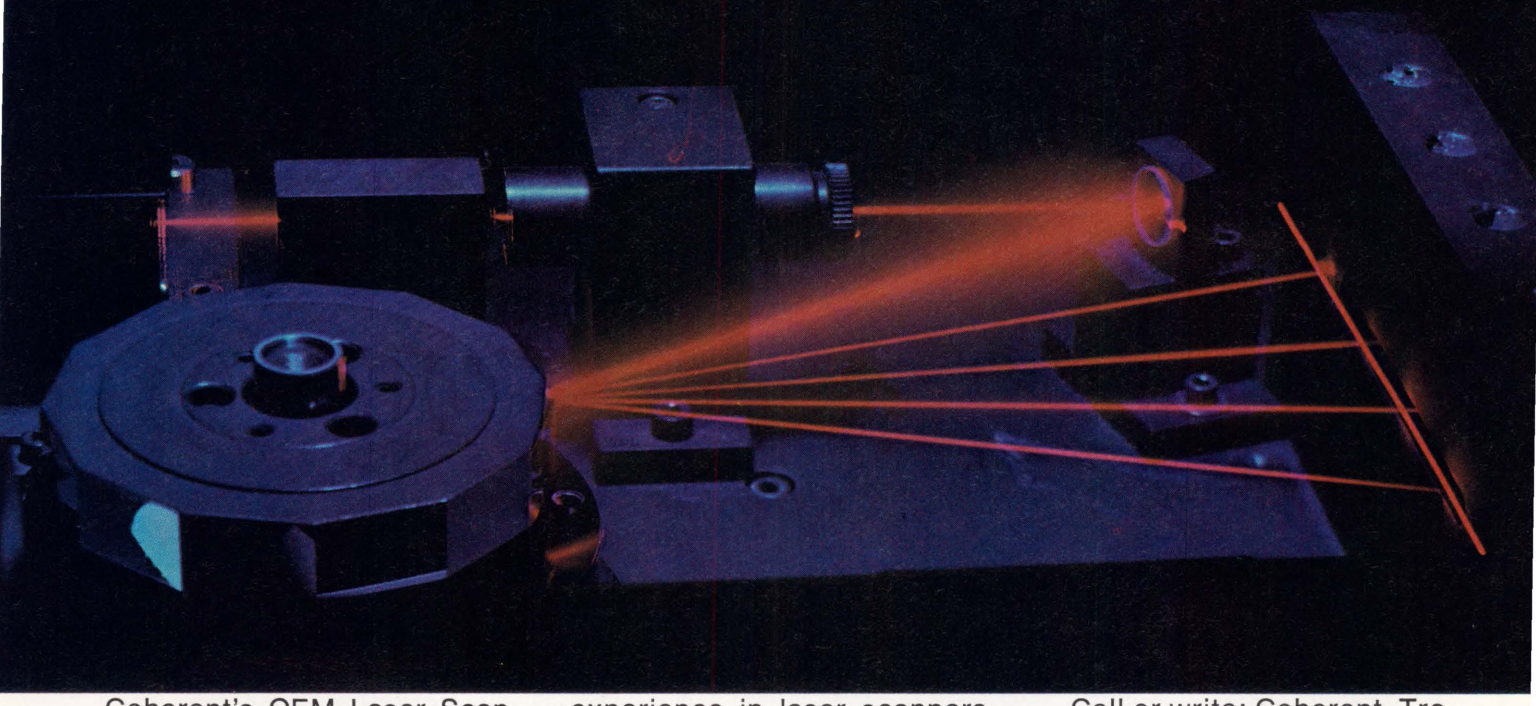
The controller circuit can convert bit-serial line data to either an 8- or 16-bit parallel data stream for a computer bus, and at the same time perform parallel to serial conversion, to provide full-duplex operation. Transmission codes can be converted to computer codes, normally NRZI to NRZ, and in-transit streams of bits and characters are monitored for control designators and delimiters such as SYN, FLAG, and ABORT.

Deletion and insertion of bits and characters are carried out as required by the protocol being used. The device will interrupt the processor on end-of-message or on abnormal conditions such as data overrun or underrun. Cyclic redundancy check (CRC) characters are accumulated for error checking, including CCITT, CRC-16, -14, -12, and -10. Internally connecting transmitter output to receiver input provides for self-diagnostics.

Pricing for the F6856 in quantities of 100 to 999 is $24.50 for the 40-pin plastic DIP version, and $29.90 for the ceramic side-brazed package.

Circle 521 on Inquiry Card

Now... non-impact printing!



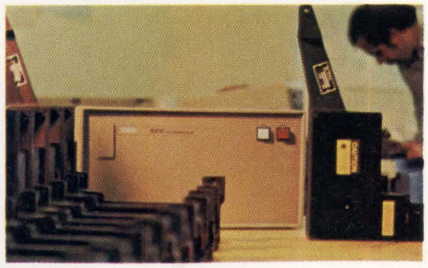
Coherent's OEM Laser Scanning Systems for non-impact printing are now available in production quantities. Our vast experience in laser scanners for the copier industry will help provide the optimum production system for you.



Printed on a Xerox® 6500 Colorgraphic* printer.

Vertically integrated, we manufacture all parts of the system: lasers, modulators, polygons, electronic circuitry and optics. This powerful technological base results in cost efficient, high performance systems.

Call or write: Coherent, Tropel Division, 1000 Fairport Park, Fairport, New York 14450, 716-377-3200.

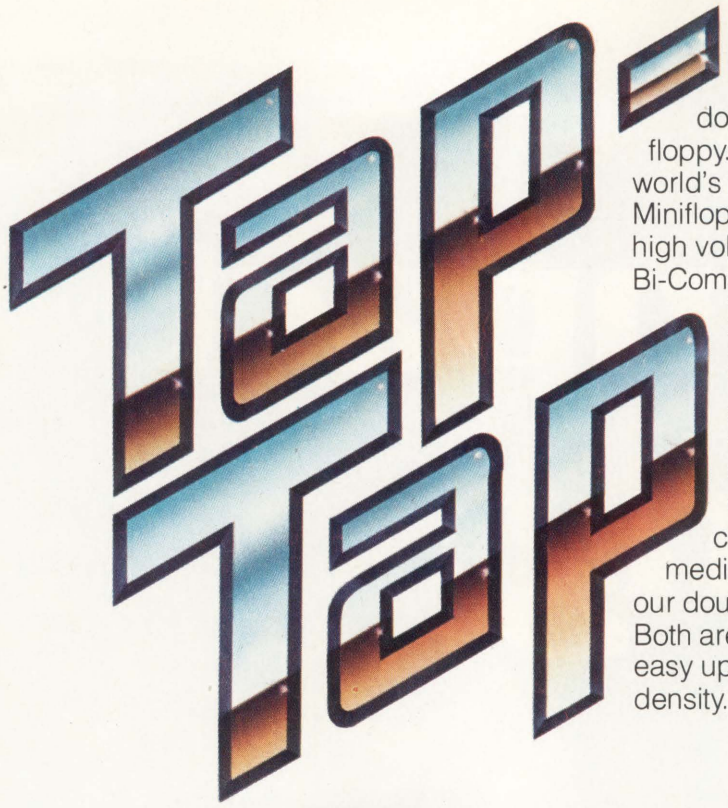


Coherent's OEM Laser Scanner production line.

*Xerox® and 6500® are trademarks of Xerox Corporation.

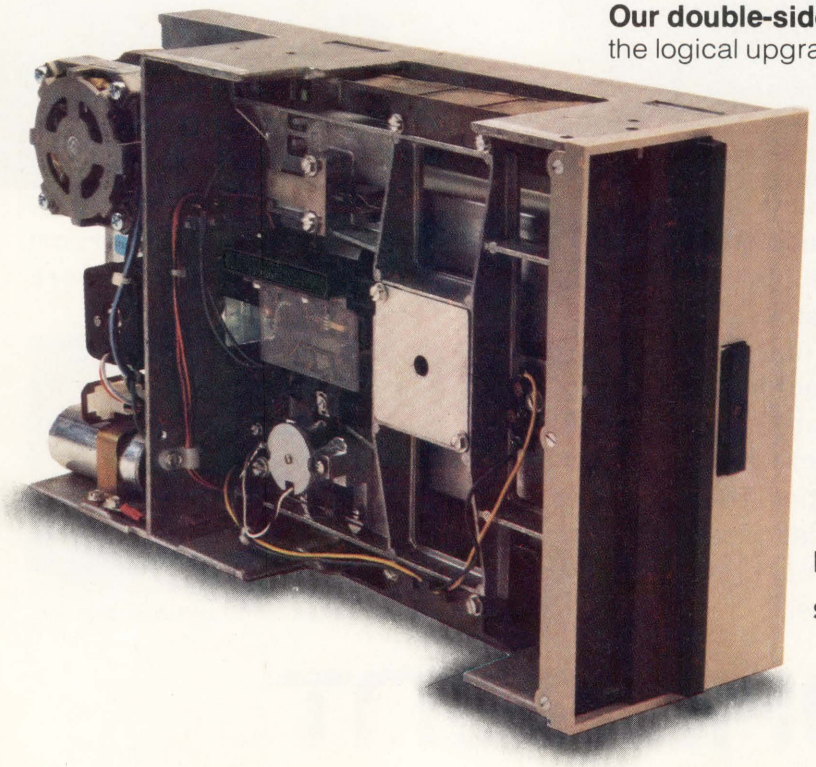
COHERENT
TROPEL DIVISION

CIRCLE 23 ON INQUIRY CARD



Shugart gives you two ways to go double-sided. Floppy or Minifloppy™. Our SA851 series is the double-sided version of the world's most popular 8-inch floppy. And our SA450 is the double-sided version of the world's most popular 5¼-inch flexible disk drive—the Shugart Minifloppy. We designed our double-sided floppy drives for high volume production with outstanding reliability. Our new Bi-Compliant™ double-sided head assembly was designed by the most experienced read/write head team in the industry. Our read/write heads are precisely aligned with our proprietary optical alignment system. And we also invented the "Tap-Tap" test, which insures that our double-sided drives can perform tens of thousands of load/unload operations on the same track location without media wear. The bottom line for you is excellent compliance resulting in superior data reliability, assured media interchange, and longer head and media life. Both of our double-sided drives let you store more data in less space. Both are compatible with their single-sided brothers for an easy upgrade. And they both operate in single or double density. But which one is best for your application?

There's a great heading

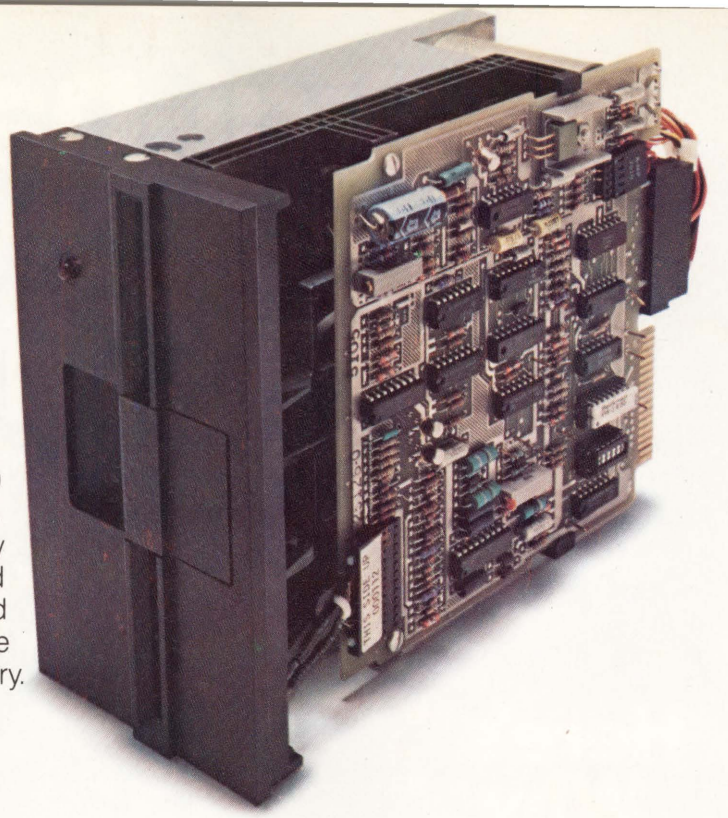


Our double-sided floppy. The SA851. The SA851 series is the logical upgrade from standard single-sided drives. Our SA851 doubles capacity to 1600 KBytes (unformatted, double density) for only about 50% more in drive cost. And to make your upgrade easier, the SA851 is the same size as our single-sided SA801 drive and I/O compatible. SA851 double-sided drives make an excellent back-up for Shugart fixed disk drives, too. All for a lower cost per kilobyte than you are paying now. Shugart's Fasflex™ band actuator cuts track-to-track access time to three milliseconds. And you can read and write data on any standard single-sided diskette as well as the IBM Diskette 2, 2D, or equivalent. Features such as single/double density recording, write protect, and programmable door lock are standard.

See us at NCC Booth #2462

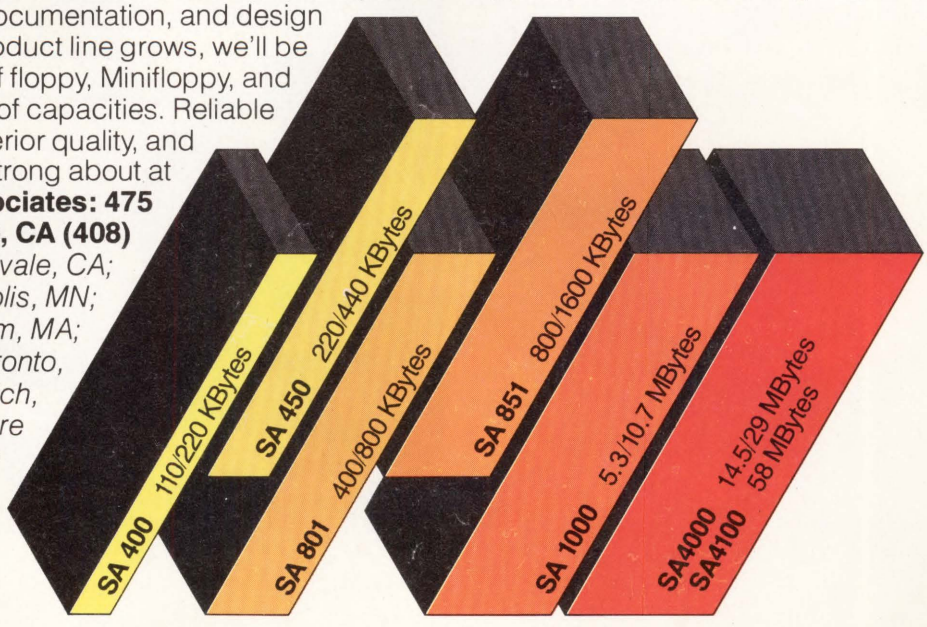
™ Trademark of Shugart

Our double-sided, double density Minifloppy. The SA450. When you need the lowest cost random access data storage in the most compact package, the SA450 double-sided Minifloppy is your best choice. It is the perfect upgrade for microprocessor-based systems using single-sided Minifloppy drives or cassette tape. The SA450 increases unformatted capacity to 218.8 (single density) or 437.5 kilobytes (double density). This double-sided Minifloppy is the same size as our SA400 single-sided model, and is I/O compatible. DC drive motor, write protect, and activity light are standard. And you can read and write data on any single or double-sided minidiskette, so your customers can continue to use their existing disk library.



double feature your way.

Choose the Headstrong double-sided floppy disk drives. No matter which of our double-sided floppy drives you select, you get the competitive edge when you go with Shugart. We are Headstrong about helping to keep you competitive too, with high volume deliveries of drives that offer superior reliability, quality, and value. This Shugart commitment is also backed by all the support you need including helpful technical services, in-depth documentation, and design assistance. And when your product line grows, we'll be there with a complete family of floppy, Minifloppy, and fixed disk drives in a full range of capacities. Reliable products, volume delivery, superior quality, and value. That's what we're Headstrong about at Shugart. □ **Shugart Associates: 475 Oakmead Parkway, Sunnyvale, CA (408) 733-0100.** *Sales & Service: Sunnyvale, CA; Costa Mesa, CA; Minneapolis, MN; Richardson, TX; Framingham, MA; Landing, NJ; Atlanta, GA; Toronto, Ontario; Paris, France; Munich, Germany.* □ *Shugart products are also available off the shelf from local Hamilton/Avnet outlets.*



Shugart

Headstrong about double-sided value

CIRCLE 24 ON INQUIRY CARD

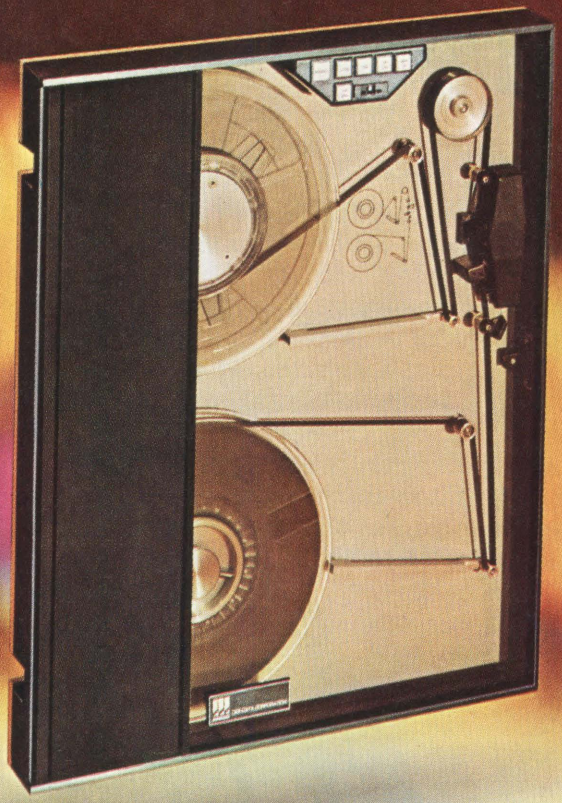
Digi-Data's Best Customers Have Switched From the Competition...

Here's Why:

- they can depend on Digi-Data's product performance and reliability . . . assured by clean, simple design and proven in over 10,000 installations.
- they choose from 192 recorder models to get the speed, format and reel size to meet their every need.
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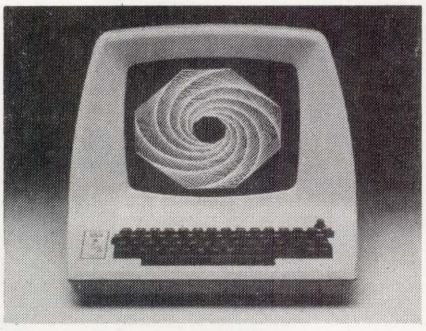
CIRCLE 25 ON INQUIRY CARD

PC Board Adds Graphics Capabilities to CRT Terminal

A printed circuit board which can be installed by the user enables operation of the ADM-3A Dumb Terminal® to operate in three modes: ADM-3A alphanumeric, graphics, and Tektronix 4010 alphanumeric. The board contains a microprocessor, 512 x 250 plotting resolution, raster synchronization and CRT refresh, and Tektronix software compatibility. It is plug compatible with the ADM-3A, a product of Lear Siegler, Inc, Data Products Div, 714 N Brookhurst St, Anaheim, CA 92803.

The card, designated RG-512 Retro-Graphics™, is from Digital Engineering Inc, Sacramento, Calif, and supplies a powerful set of vector drawing and point plotting capabilities to effect the conversion.

The two firms have signed a 1-year mutual marketing and development support agreement, under the terms of which Digital Engineering will develop custom data representation graphics equipment for Lear Siegler's video terminals, and the terminal manufacturer will support Digital Engineering's marketing efforts through its distributor network and customer base. The board will be sold separately or installed in the ADM-3A by distributors.



Combined data entry/graphics CRT terminal. PC board mounts below terminal's main electronic board and provides graphics capabilities in low cost package. Terminal also operates as alphanumeric device for data entry applications. ADM-3A has 12″ (30.5-cm) diagonal screen with 24 lines, 1920 characters in upper case, punctuation, and control

Price for the RG-512 card is $1150 and for the video terminal $895, the combination being effectively half the cost of similar graphics terminals, according to the company.

Circle 522 on Inquiry Card

glitch \'glich\ *n* [prob. fr. German *glitschen*, to slide] **1:** Originally, an unwanted, false electronic pulse. **2:** Now, any of a variety of problems that plague both hardware and software in digital designs. syn spike, snarp.

glitchfixer \'glich fik-ser\ *n* [only from Gould] **1:** A Biomation logic analyzer with 8, 9, 16, 27 or 32 channels, sampling rates to 200 MHz, and memory lengths to 2048 words. **2:** The ultimate solution to troubleshooting digital logic.

Got a glitch? get a GLITCH FIXER FROM GOULD

GOULD

An Electrical/Electronics Company

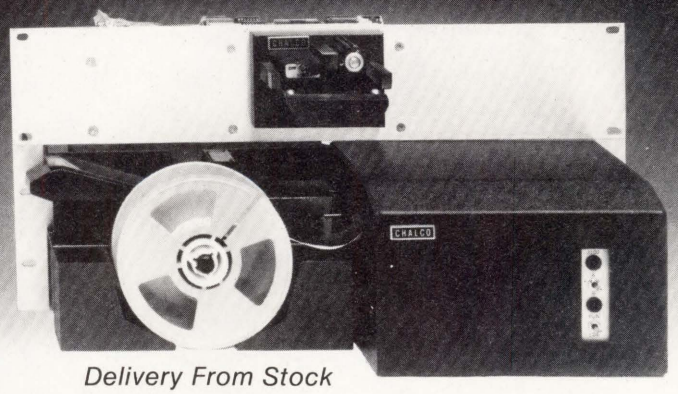
4600 Old Ironsides Drive, Santa Clara, CA 95050
For a Glitchfixer catalog, call Bob Lorentzen at (408) 988-6800

CIRCLE 26 ON INQUIRY CARD

New

COMBO

can be separated



Delivery From Stock

TAPE PUNCH $1315
50 ch/s - 50-60 hz - 5, 6, 8 Level
Roll & Fanfold Payout

Options
RS-232C Interface*
Take-up Reel/Bins - TTS Tape

TAPE READER $670
1,000 ch/s - 50-400 hz - 8 Level

Options
RS-232C Interface*
Unwinder/Rewinder - Fanfold Bins
5, 7, 8 Level, TTS Tape

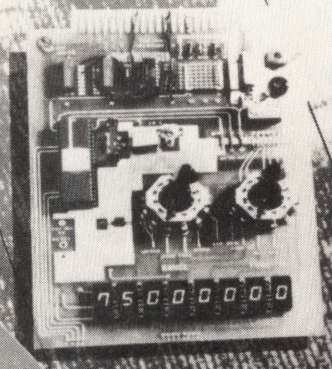
***ONE INTERFACE** serves both Punch and Reader, **$250**

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Gardena, California 90248
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CIRCLE 27 ON INQUIRY CARD

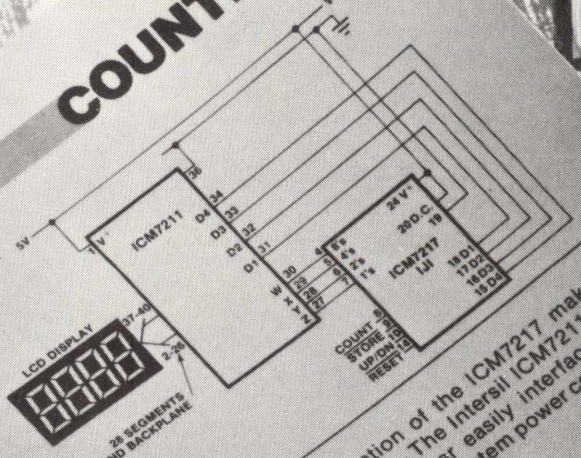
INTERSIL

Timers Counters Display Drivers Applications Handbook



"Thunder is good, thunder is impressive; but it is lightning that does the work."

COUNTERS

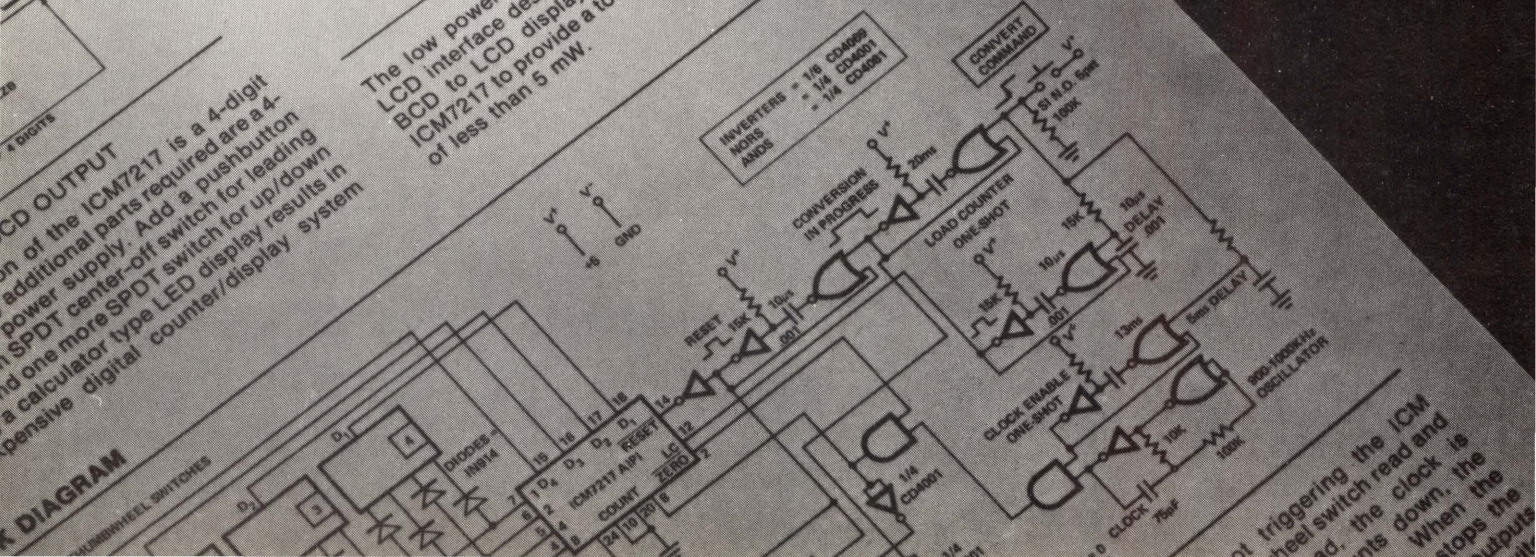


The low power operation of the ICM7217 makes an LCD interface desirable. The Intersil ICM7211 4-digit BCD to LCD display driver easily interfaces to the ICM7217 to provide a total system power consumption of less than 5 mW.

CD OUTPUT

on of the ICM7217 is a 4-digit additional parts required are a 4- power supply. Add a pushbutton SPDT center-off switch for leading d one more SPDT switch for up/down a calculator type LED display results in pensive digital counter/display system





K DIAGRAM

UMBWHEEL SWITCHES

triggering the ICM heel switch read and d, the clock is nts down. When the ops the utputs

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Answers to timing, counting and display driving problems. Answers from Intersil. Single-chip answers. Answers in low power CMOS. In fact, answers in MAXCMOS,™ Intersil's proprietary CMOS process.

DOZENS OF ANSWERS.

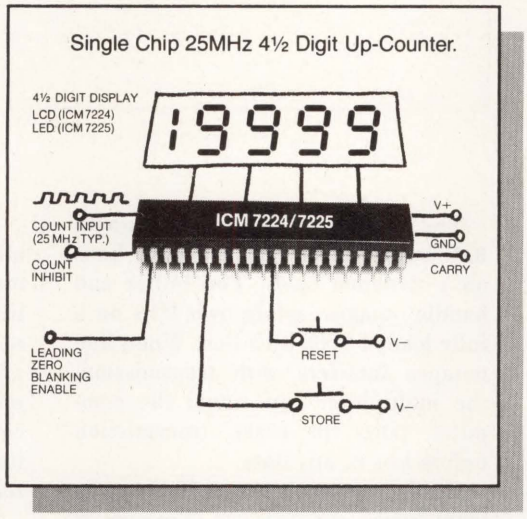
Whether you're planning timer / counter / display functions for a microprocessor-based or hardwired system, we think you'll find an Intersil chip that does the job.

SYSTEMS ON A CHIP.

While they were thinking circuits, we were thinking systems. Systems on a single chip that replace up to 20 TTL packages. That means you can design systems faster, use less real estate, and gain the reliability that's inherent not only in lower component count...but in low power CMOS operation.

DISPLAY IT YOUR WAY.

Intersil's display drivers drive LED, LCD and Vacuum fluorescent displays. Displays up to 1″ in height. And, you can cascade displays to 32 or more digits.



COUNT IT YOUR WAY.

Count units, period, frequency or time interval. With Intersil's advanced monolithic low power MAXCMOS™ counters.

TIME IT YOUR WAY.

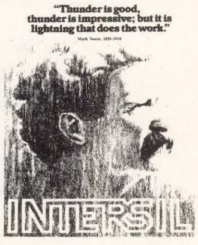
Time events from microseconds to months. Intersil offers devices that feature user programmability or offer fixed outputs utilizing a stable quartz crystal time base.

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The Timers, Counters, Display Drivers Applications Handbook is yours. Free. From any Intersil Sales Office, Intersil Franchised Distributor, or simply by returning the coupon below. We wrote "The Book." For you.

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_____ timing, _____ counting, _____ display driving applications.
_____ Send me your Mark Twain poster.

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Address_____

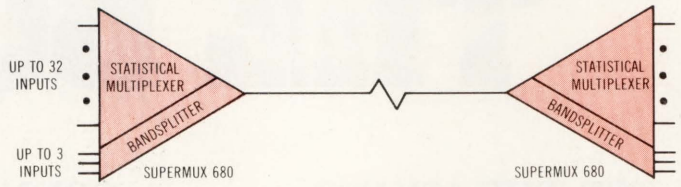
City_____ State_____ Zip_____

CD 580

Statistical Multiplexer Provides Priority Control, Data Compression

Throughput and CPU scheduling are improved by priority/no priority switches at the 32 channel inputs of the Supermux 680 statistical multiplexer. The switches establish priority of each input for bandwidth on the high speed output line. This capability minimizes delays for high priority inputs and may also be used to maximize output line utilization, according to Infotron Systems Corp, Cherry Hill Industrial Center, Cherry Hill, NJ 08003. High speed line efficiency is also improved by a switch-selectable data compression capability. A unique algorithm applied to data that lends itself to compression, such as tabular data, achieves compression rates approaching 45%.

The 680, using dynamic bandwidth assignment, enables up to 32 input lines with combined aggregate speed of 38,400 bits/s to be concentrated over a single 9600-bit/s output channel. Inputs may be any combination of dial-up or dedicated lines, synchronous or asynchronous with mixed protocols and speeds to 9600 bits/s. Automatic baud recognition (ABR) allows recognition of the speed of dial-up inputs, so that there is no need for dedicated lines, computer ports, and telephone rotaries of separate speeds. The microprocessor controlled unit uses statistical techniques to transmit only active data inputs.



Bandsplitter module for 680 multiplexer. Device allows dividing 680 output channel into separate bands and accommodates up to 4 synchronous inputs. Input speeds must be increments of one-fourth high speed output line rate

The multiplexer includes a 32k-byte RAM buffer, shared by all input lines on a dynamic basis. The buffer can handle outages lasting over 20 s on a fully loaded 9600-bit/s line. When line outages interfere with transmission, the multiplexer can signal the computer ports to cease transmission before loss of any data.

On the output side, speeds are up to 9600 bits/s, synchronous. Protocol is similar to SDLC and X.25 level 2 framing with flag, zero insertion, and 16-bit CRC. Variable block length is 128 chars max. Data are temporarily buffered for the CRC. When errors are present the receiving 680 issues an ARQ and data are retransmitted and rechecked.

Flow control is handled for terminals that use XOFF or other commands that signal the host to stop transmitting data. The 680 at the terminal end recognizes the command and stops sending data to the terminals. However, it allows the CPU to continue transmission and generates its own XOFF message when the buffer reaches 80% of capacity.

An array of panel indicators reports on system status. A separate channel sends reports to any ASCII-compatible CRT or printer for hardcopy readout on line utilization, transmit buffer utilization, and any unusual system event.

The unit is transparent to terminals, CPUs, and software, and may be installed without change to existing systems. Plug-in modules permit initial installation to service only a few channels with provision for later expansion.

Circle 523 on Inquiry Card

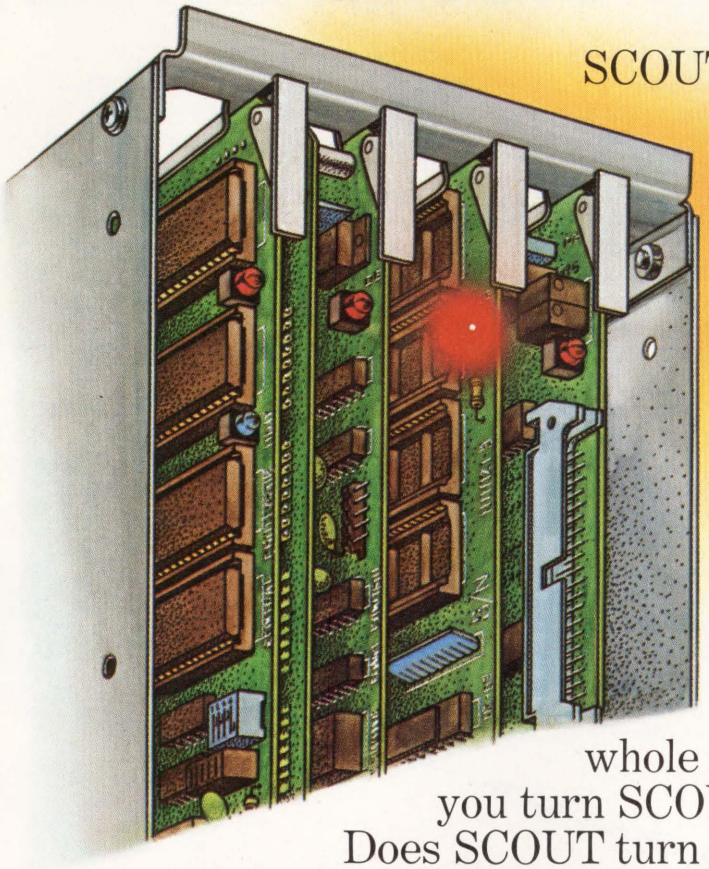
Girl-meets-flat-cable and lives happily ever after.

See page 46

Communications Functions Added to Word Processing Systems

Six major data communications products have been made available for use on its VT word processing systems by Lexitron Corp, 9600 DeSoto Ave, Chatsworth, CA 91311, a unit of Raytheon Data Systems. All options

Speak SCOUT, speak.

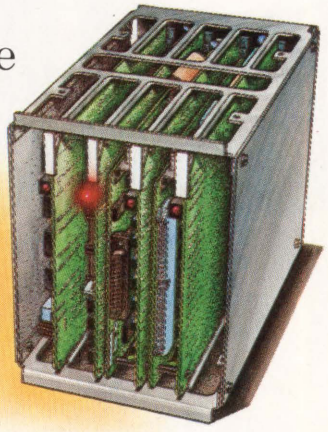


SCOUT™ is a smart minicomputer. He can tell you when one of his boards is bad. Good SCOUT!

How does SCOUT do this? SCOUT has ISOLITE.™ Do you see the red light? It means ISOLITE is testing the board. If the light stays on, the board is bad. Bad boards don't get to play anymore. They get replaced with a spare 6.25″ x 8.3″ card in about three minutes.

Isn't ISOLITE neat? It can even test your whole system every time you turn SCOUT on.

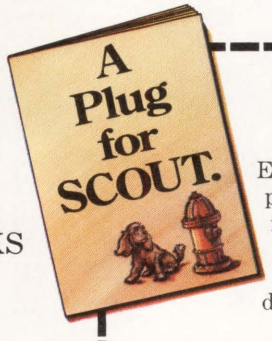
Does SCOUT turn you on?



Think what three-minute maintenance could do for your bottom line. Think what it could do for your product line. Everyone will love your products. You will grow very rich.

You will save up front, too. SCOUT starts at less than $1K for a 16-bit CPU, I/O, 32K Byte RAM and card cage. So, SCOUT also speaks to value.

Speak SCOUT, speak.



See the light.

Every bit of the 16-bit performance you need, plus incredible operating economy. It's all in our how-to-save-on-maintenance primer, *A Plug for SCOUT.* Get your free copy with this coupon and a business card. Or, for immediate information, call 714/833-8830, Ext. 455.

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See SCOUT run At NCC Booth #3014.

CIRCLE 28 ON INQUIRY CARD

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Ideals tell you to design for performance. STC's product plan

Balancing your I/O performance objectives against your company's cost objectives can be a vexing challenge. STC is ready to help you resolve the dilemma with the most comprehensive offering of tape subsystem products and capabilities ever offered to the OEM.

Improving Performance

The 1900 Tape Family provides a choice of 9 basic subsystem configurations. So you can pick the precise combination of speeds, densities and features to complement your processor and your customers' applications. The chart on the right will help you start sizing up the appropriate model.

In demanding processing environments GCR (6250 bpi) is the obvious choice. For example, a GCR tape drive can handle a 100 Mbyte disk dump/restore with a single reel in as little as 4 minutes. (Compared to 4 reels and 20 minutes for PE.) On long sequential files, a 125 ips GCR drive will actually outperform most disk drives. Best of all, GCR performance comes with a significant bonus in read/write reliability.

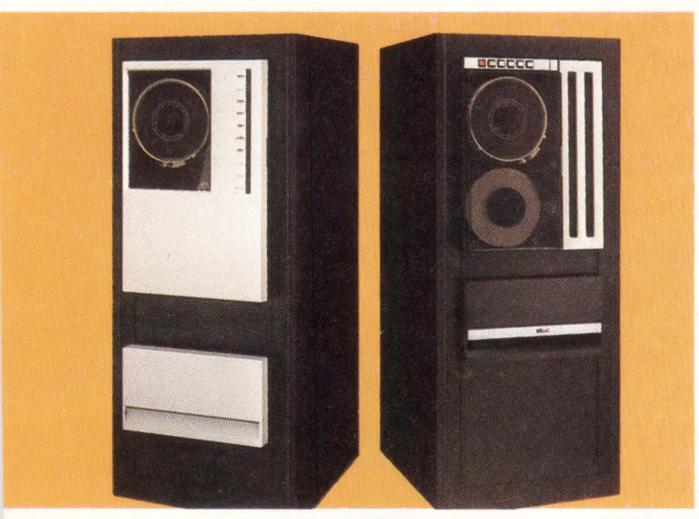
NRZI (800 bpi) and PE (1600 bpi) give your customers the ability to process archival data and to exchange information with systems lacking GCR capability. STC's 1953 lets you handle all three of these popular formats in a single drive/single formatter configuration.

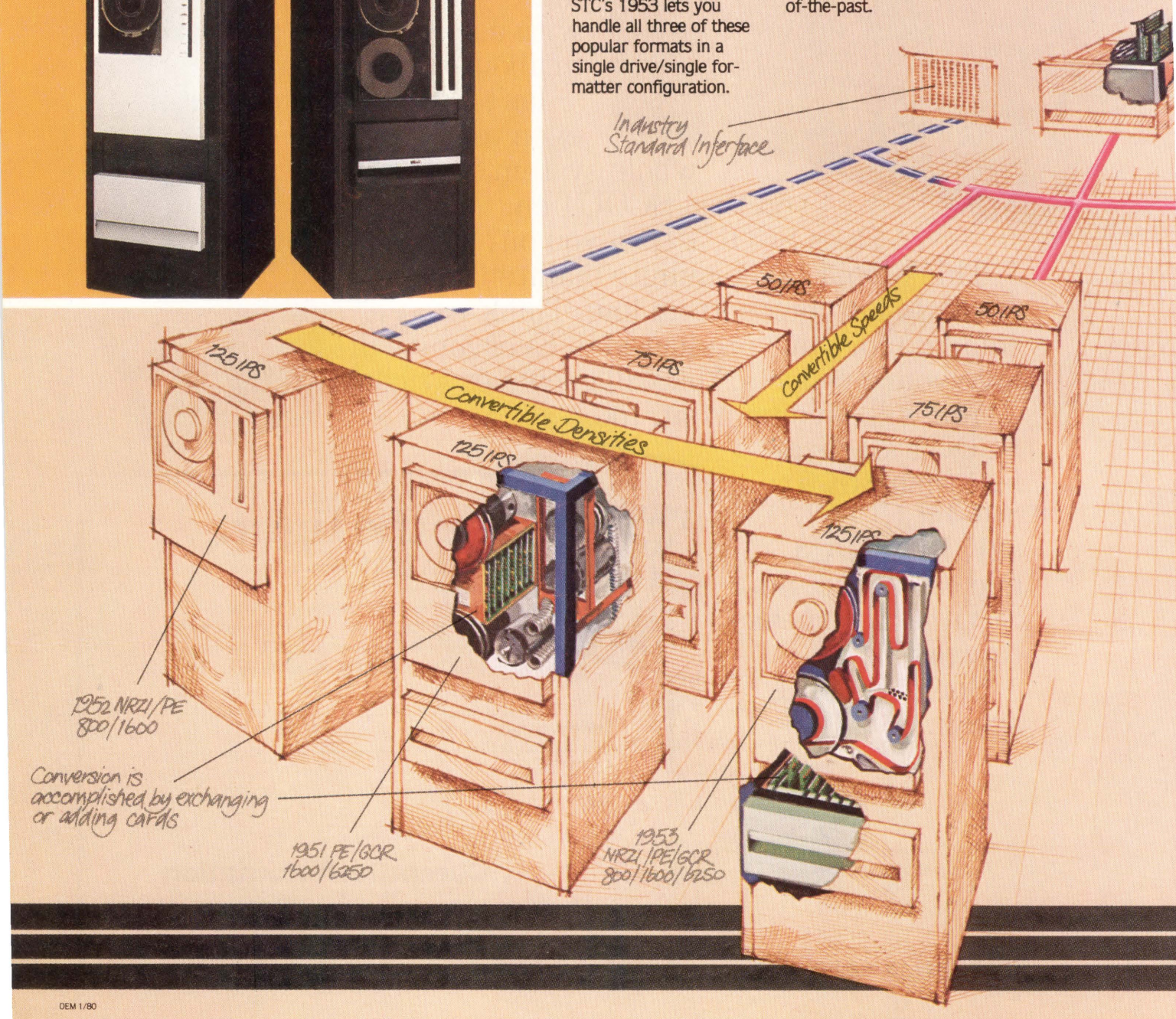
Controlling Factory Costs

If your company markets a line of systems to meet a variety of customer requirements, the STC 1900 can simplify your engineering and cut your costs.

The 1935 Formatter/Control Unit will handle up to four 1950 and 1920 Series Drives, intermixed in any combination of speeds and densities. That means a single hardware interface and a single set of operating system drivers and utilities can accommodate all the configurations in your marketing mix.

More good news. The seven 1950 Series Drives models have a 90% plus parts commonality. The same is true of 1920 Series Drives. So training is simplified and spare parts headaches are a thing-of-the-past.





Practicality says design to cost. gives you both.

And for the ultimate in flexibility, 1900 subsystems provide a convenient growth path. With a few simple card changes, your field engineers can convert speeds and densities, on-site, in a matter of minutes.

Containing Service Costs

To assure fast, effective field service, STC provides you with the most comprehensive diagnostics in the industry. The 1900 Diagnostic Software features more than 180 routines including functional, reliability and artificial stress testing. Field experience has shown the package will deliver 95% fault detection and 70% isolation to one of three cards.

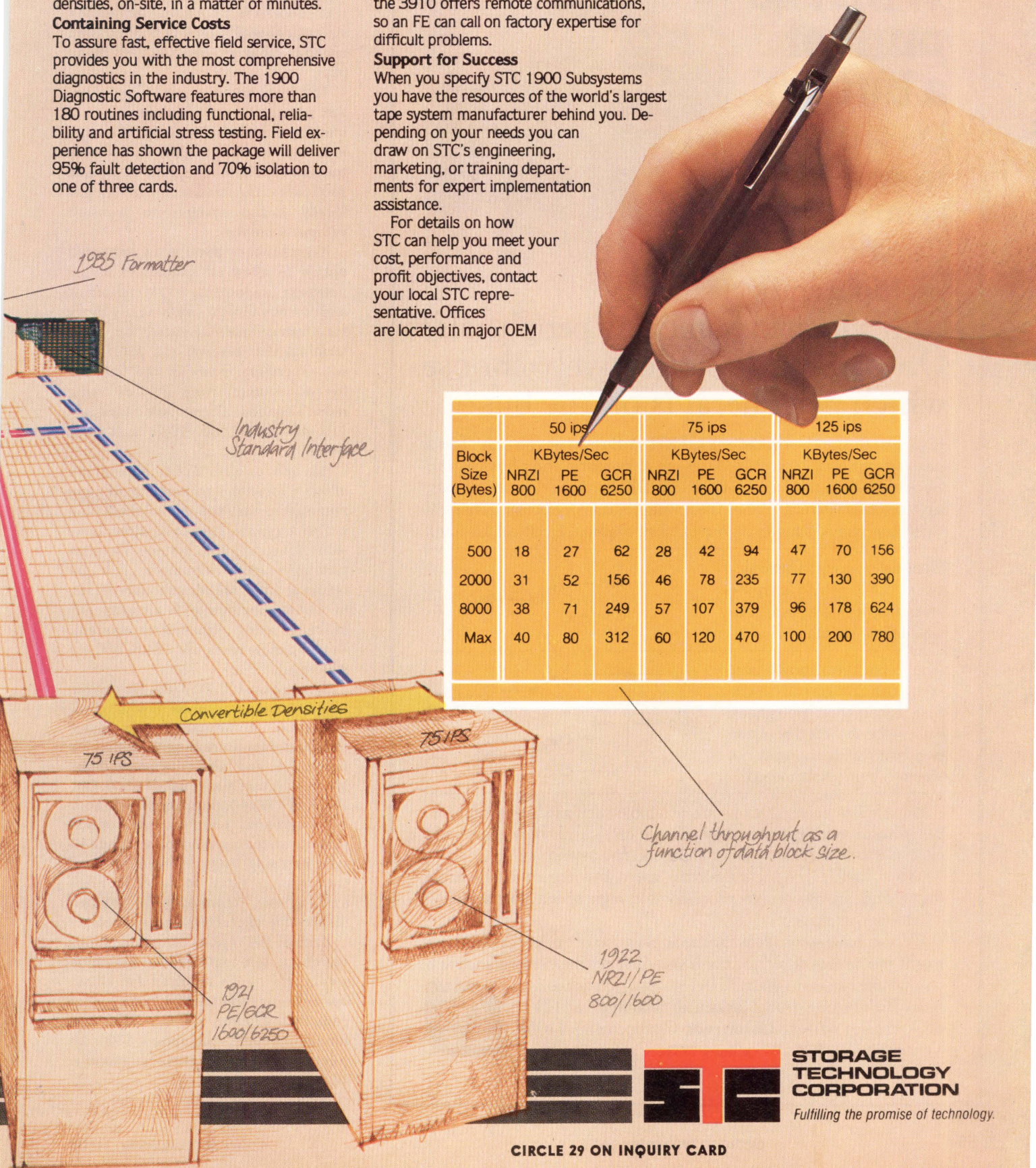
Your field engineers can run these routines on-line via the customer's processor or off-line via STC's 3910 Diagnostic processor. In addition to its powerful local capability, the 3910 offers remote communications, so an FE can call on factory expertise for difficult problems.

Support for Success

When you specify STC 1900 Subsystems you have the resources of the world's largest tape system manufacturer behind you. Depending on your needs you can draw on STC's engineering, marketing, or training departments for expert implementation assistance.

For details on how STC can help you meet your cost, performance and profit objectives, contact your local STC representative. Offices are located in major OEM centers around the world.

Or write Storage Technology Corp., P.O. Box 6, 2270 S. 88th Street, Louisville, CO 80027. Phone (303) 673-5151.



Block Size (Bytes)	50 ips KBytes/Sec NRZI 800	PE 1600	GCR 6250	75 ips KBytes/Sec NRZI 800	PE 1600	GCR 6250	125 ips KBytes/Sec NRZI 800	PE 1600	GCR 6250
500	18	27	62	28	42	94	47	70	156
2000	31	52	156	46	78	235	77	130	390
8000	38	71	249	57	107	379	96	178	624
Max	40	80	312	60	120	470	100	200	780

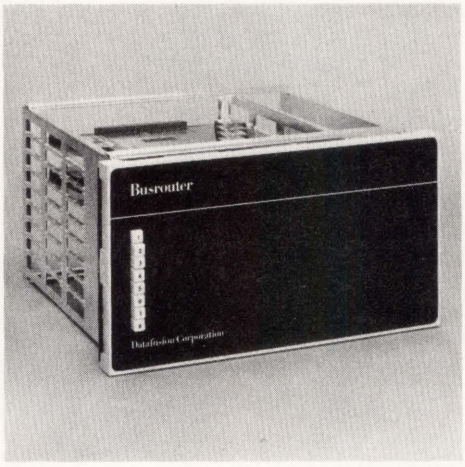
Channel throughput as a function of data block size.

STORAGE TECHNOLOGY CORPORATION

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CIRCLE 29 ON INQUIRY CARD

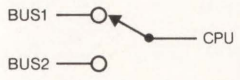
Reconfigure your PDP11 Unibus* with the push of a button.



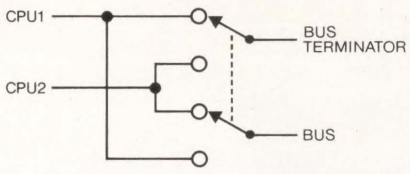
Do you need to share peripherals? Do you have multiple cpu's with a limited number of peripherals? Do you need to selectively choose which peripheral is on the bus?

If so, Datafusion Corporation's OSR11-A Busrouter can help. It is a passive, manually operated device to perform the physical and electrical switching of the Unibus* for PDP11 series computer systems: up to eight switching planes (i.e., configurations); electromechanical switching relays (simple, high reliability, minimal electrical loading).

Essentially, each Busrouter switching plane can be viewed as a single pole, multiple throw switch.



The application shown here is a situation opposite the first, where one peripheral bus can be switched between two cpu's with the cpu not selected being terminated.



Many more configurations are available such as sharing multiple peripheral devices between multiple cpu's and then selectively choosing to switch each one or all to one cpu or another.

Other PDP11 products available are a bus repeater, bus cable tester, and an associative processor for high speed text search — a hardware approach.

We also have some ideas for the application of our products which might not have occured to you. If you can't get the performance that you would like from your PDP11 system, maybe we can help. Telephone our Marketing Manager at (213) 887-9523 or write to Datafusion Corporation, 21031 Ventura Boulevard, Woodland Hills, California 91364.

*TRADEMARK OF DIGITAL EQUIPMENT CORPORATION

are software-controlled and operate on a menu selection basis. VT systems equipped with appropriate firmware can be converted to communicating text processors by loading any of the six options and selecting transmission criteria from an interactive menu page.

The asynchronous point to point option permits VT systems to be linked to one another for electronic mail and message sending. User selectable transmission rates are 300, 1200, and 2400 bits/s; the last allows directly and locally linked systems to transmit without a modem.

Asynchronous ASCII is an enhanced option to allow all systems to access networks supporting TTY terminals and to communicate with nearly every mainframe, minicomputer, or other terminal that receives the ASCII code set. Operators establish the link between communicating devices using menu selection. Transmission rates are 110, 150, 300, 600, 1200, and 2400 bits/s.

Asynchronous 2741 emulation allows VT systems to function as communicating text processors emulating a 2741 terminal. It enables direct links with IBM-compatible systems for such functions as information storage/retrieval from mainframe data bases, or communications with virtually any current word processing system. Transmission rates are 134.5, 300, or 1200 bits/s.

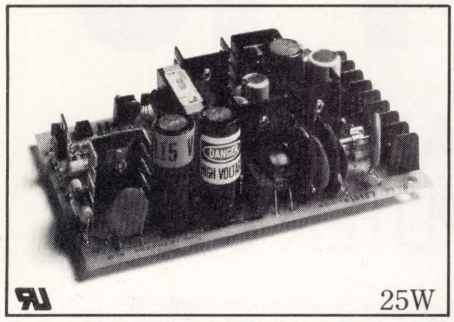
Synchronous 2780/3780 emulation, two options on separate media, allow emulation of IBM-compatible bisynchronous data processing terminals for batch, RJE, and inquiry/response tasks. Menu selection allows use of ASCII, EBCDIC, and EBCDIC-transparent code sets.

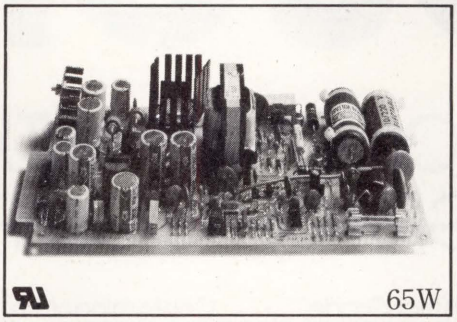
Synchronous point to point option permits system connection to other VT systems using bisynchronous protocol transmission rates up to 4800 bits/s and allows transmission of all displayable characters and symbols.

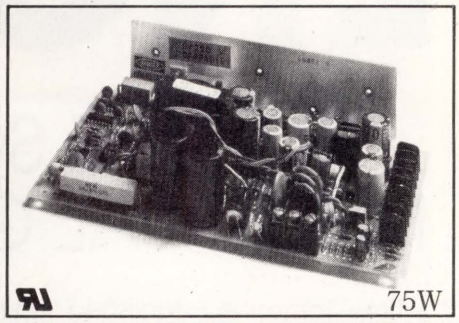
Each of the various communications options is self-contained on magnetic media. Hardware required for all six options is priced at $1200. Software for each asynchronous option is $250, and for each synchronous option, $300. All prices are single quantity. Shipment is 30 days ARO. □

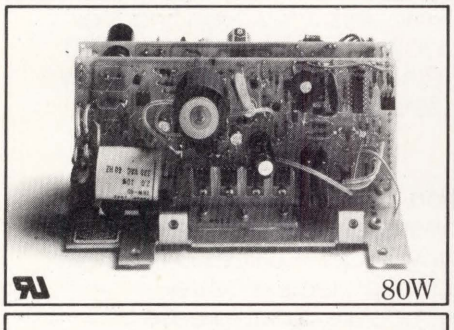
Circle 524 on Inquiry Card

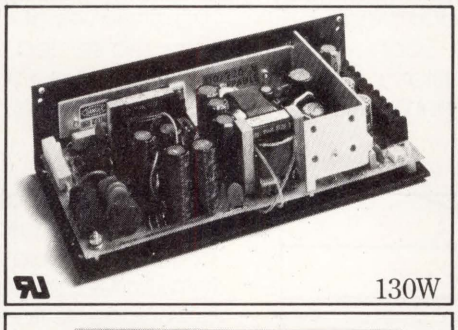
People are switching to Boschert

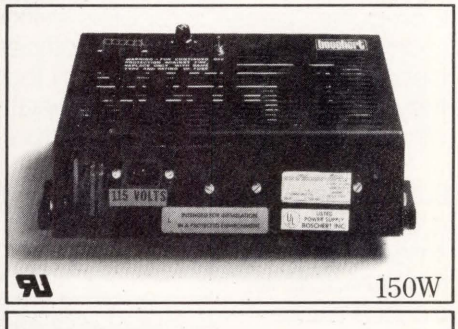

25W


65W


75W

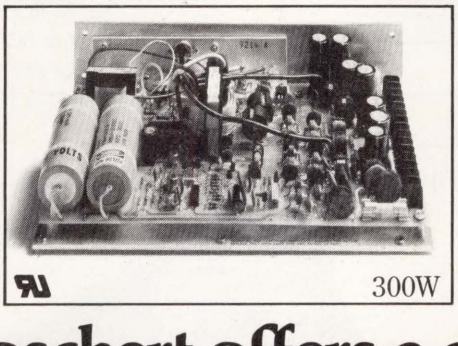

80W

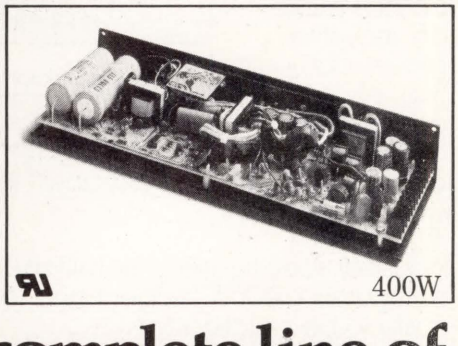

130W



150W


200W


300W


400W

because only Boschert offers a complete line of 25-400 watt switching power supplies.

When you want power, come to Boschert. We're the power leader with more standard 25-400 watt switching power supplies in production and in stock than any other manufacturer. Every one is UL-recognized. Each meets international input voltage requirements. And we offer the multiple output voltages you need to meet your particular system requirements.

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At Boschert we've been building off-line switching power supplies for almost a decade. Over 200,000 of our multiple output power systems are now in operation. Isn't it time you made the switch to Boschert?

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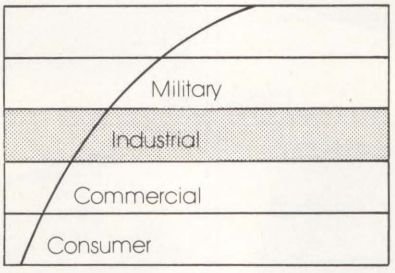
CIRCLE 31 ON INQUIRY CARD

ENOUGH IS

IT'S TIME SOMEONE ESTABLISHED 'INDUSTRIAL GRADE' COMPUTER SPECS

It's Time Someone Established 'Industrial Grade' Computer Specs. Computers started in clean rooms and then moved into offices. Soon people tried to put them out in the plants where they couldn't stand up to the heat, humidity and other hostile environmental factors.

But, just because a computer is smart enough to run a machine doesn't make it an 'industrial grade' computer. Too much computer hardware that is billed as 'industrial' breaks down in the real world of the plant.



Industrial specifications for military computers are too stringent and too costly to be practical for industrial applications.

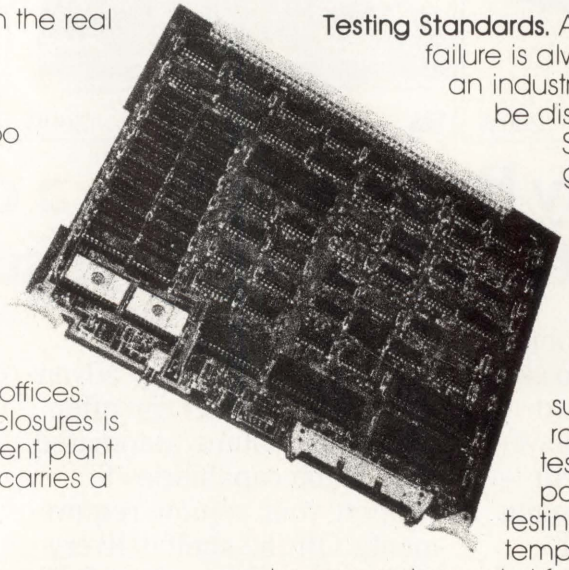
Temperature. We believe that the minumum acceptable 'industrial grade' temperature specification should be 60°C. Factories are not comfortable like offices. The temperature inside sealed enclosures is usually 15°C higher than the ambient plant temperature. XYCOM's '180+' line carries a 65°C specification.

Relative Humidity. In a plant, a computer should have a tolerance to relative humidity levels from 0% to 100%. They should also have resistance to condensation. The new XYCOM '180+' line with XYCOAT™ meets this stringent demand.

Vibration. Failures due to vibration are virtually always the result of faulty connections, boards or chips. To meet 'industrial grade' spec, chips should be soldered to the board and EPROMs clipped to their sockets. in addition, units should be subjected to 100% full vibration stress and subsequent testing to ensure maximum product integrity.

Contaminant Protection. Salts, dust, dirt and oils are enemies of computers. They even find their way into sealed cabinets in plants. The XYCOM '180+' line is XYCOATed to keep contaminants from the boards. (See corrosion.)

Corrosion Protection. Plants are killers when it comes to atmospheric contaminants that corrode and destroy. XYCOAT utilizes a specially formulated shield that protects module components from moisture, fungi, grease, oxidation, salt spray, acids, alkalis, and many other harmful elements. In addition, XYCOM connectors are industry proven gold.



Testing Standards. A computer failure is always bad, but in an industrial situation it can be disastrous. Testing Standards for 'industrial grade' should be higher than for 'commercial grade' All components and assemblies should be tested at all stages of production. They need to be subjected to the full range of dynamic testing which includes power cycling and stress testing under extreme temperatures under microcomputer control for up to 72 hours. This is in addition to our stress vibration cycle. All XYCOM products are tested to our 'industrial grade' standards.

Warranty. For industrial purposes a warranty needs to cover the period soon after installation when most failures will occur. We believe that a year warranty offers the most desirable cost to reliability ratio for both manufacturer and user. It is our philosophy that, although the extent of our testing is extensive, the resulting savings due to greatly reduced warranty claims keeps XYCOM products competitive and your plant operating.

ENOUGH!

...AND STOP SENDING BOYS TO DO MEN'S WORK

Introducing the XYCOM 180+ Line. Now, we are setting a new standard for the others to match. Every '180+' module is XYCOATed and uses gold connectors. Our regular 180 line meets most 'industrial grade' specs which is sufficient for most factories. The '180+' line exceeds 'spec' and is for even tougher environments.

COMPARE 180+™ 'SPEC FOR SPEC'

We've told you what we think 'spec' should be. Look at how our '180+' line shapes up and compare us with any other product that espouses to the 'industrial grade' designation.

Common Features	Intel	DEC	Motorola	Others	XYCOM 180+
Temperature					65°C
Relative Humidity					0% – 100%
Vibration					100% Vibration Stress
Contaminant Protection					XYCOAT meets petroleum industry standards
Testing Standards					100% Accelerated burn-in with power cycling, full dynamic testing
Warranty					1 year

Specific '180+' Features

Digital I/O: T^2L I/O, 64 channel.
64 channel power out.

CPU: Minimum Cost CPU.
High Performance CPU.

Memory: Multiple 65k EPROM cards.
Multiple 65k RAM cards.

Analog I/O: 12 bit, 300 v common mode integrating A/D.
8 channel, 4 to 20 ma isolated D/A.

Software: Multitasking Runtime Executives, Assembly. Fortran IV, Industrial Pascal.

Accept the XYCOM Challenge

(You could win a week for two to Club Med, Cancun.)

We want you to compare the XYCOM '180+' line with any other product that aspires to the 'industrial grade' designation. Just fill in the specifications for any competitive industrial computer, fill in your name and address and send your entry to us. Everyone that makes a comparison gets a gift. One entry per person. The grand prize winner will be selected by drawing before September 30, 1980. Entries must be received by July 31, 1980. The trip must be taken between January 1, 1981 and May 31, 1981.

Name _____ Title _____

Co. _____ Address _____

City _____ State _____ Zip _____

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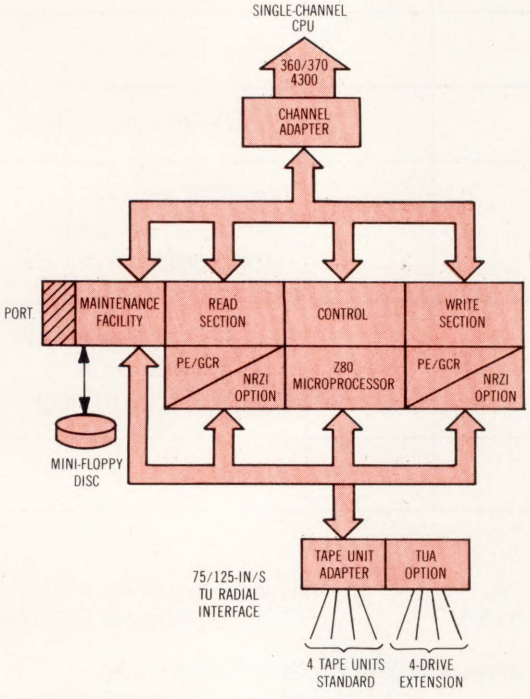
Tape Subsystems Combine High Performance With Inline Microdiagnostics

4500 series tape drives combine high performance advantages of large system tape drives with price and size advantages of smaller drives. Designed specifically for the midsize user characterized by IBM System/370, models 135, 138, 145, or 148, or 4300, the tape subsystem from Storage Technology Corp, 2270 S 88th St, Louisville, CO 80027 balances the fixed disc with high performance backup and productive processing.

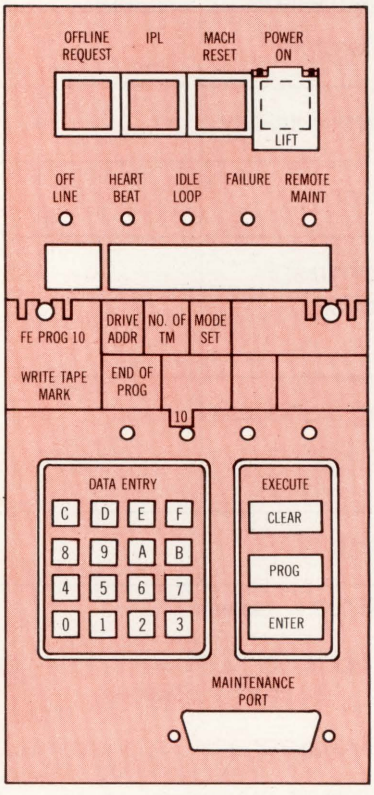
Drives are available in both 75-and 125-in (190- and 317-cm)/s speeds and will read and write in three densities. Basic mode of operation is 6250 and 1600 bits/in (2460 and 629/cm) with 800 bits/in (314/cm) available as an option. This tri-density feature allows users of 800 and 1600 bits/in to economically convert to 6250 bits/in. A key feature is built-in diagnostic capability that allows the system to be exercised inline through micro-diagnostics. Wake-up diagnostics exercise memory, microprocessor, and interface when the subsystem is powered up, insuring proper operation.

Basically two units comprise the 4500 subsystem: A1 housing control unit, maintenance facility, and one tape drive; and B1 housing each add-on tape drive. Automatic hub, power window, and auto-load features are standard. Tri-density guiding and gentle but positive tape handling are facilitated in the tape path.

The auto-hub is a high torque variety and is pneumatically automated on inception of a load command. The plexiglass power window is actuated up on a load command and down after a rewind/unload command is completed. Auto-thread/load is facilitated



Tape control unit within Storage Technology's tri-density 4500 tape subsystem contains six independent functional elements connected with microprocessor bus structure. Bipolar microsequencer in channel interface handles channel protocols, controlling communication with host CPU



Maintenance panel of 4500 subsystem makes provision for manual control functions and supplies error and status indicators that reflect machine's operation state. Keypad allows operator to invoke remote maintenance or to access diagnostic tests that initiate display of detailed internal status

DEC PDP-11 TAPE USERS

NO WAITING . . .

For the first embedded single board Magnetic Tape System Controller

Datum's new PDP-11 software compatible single board design, Model 1520 Embedded NRZI Tape Controller offers you more for less. And we're delivering them right now.

More versatility; occupies a single HEX SPC slot or comes with its own chassis, 16 bit microprocess controlled, word and or byte memory transfers with odd or even starting addresses and byte counts. TM-11 or IBM data compatibility is available. The 1520 interfaces to the Datum D450 tape drive or any industry standard tape drive (up to four can be attached). Dual Density is achieved simply by adding a second board to accommodate the Phase Encoded function. Additionally, Datum offers you Phase Encoded ID data burst detection.

And we offer you less; less initial cost*, less preventative maintenance. And you use less space thanks to Datum's advanced embedded controller design.

If you're a PDP-11 tape user and need delivery now, you owe it to yourself to learn more about Datum's more for less tape program. **For early delivery contact your local Datum representative today.**



PDP-11 SOFTWARE COMPATIBLE



datum inc

CIRCLE 33 ON INQUIRY CARD

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*Single board NRZI design, $3,000 Qty-1

Systems (tape drive and controller) pricing begins at $6,900 Qty-1

PPD 103

There's no waiting to see Datum at the NCC Booth 2445

ByteWyde options start with 8K static RAMs.

Mostek calls it the 4118.

To appreciate the 4118, realize first that its credentials are impressive. It's the highest density static available. The design is proven and reliable. In fact, MTBF is 285 years at 55°C.

The 4118 is also as fast as it is reliable. Access time is a scant 120ns (max.). Plus, it's available now, in quantity. At prices that are already cost-competitive with previous generation static RAMs.

Military versions of the 4118 are screened to MIL-STD 883B with access times of 150ns, 200ns and 250ns. And all three are guaranteed to operate over the full military temperature range of –55°C to +125°C.

It's a BYTEWYDE™ memory.

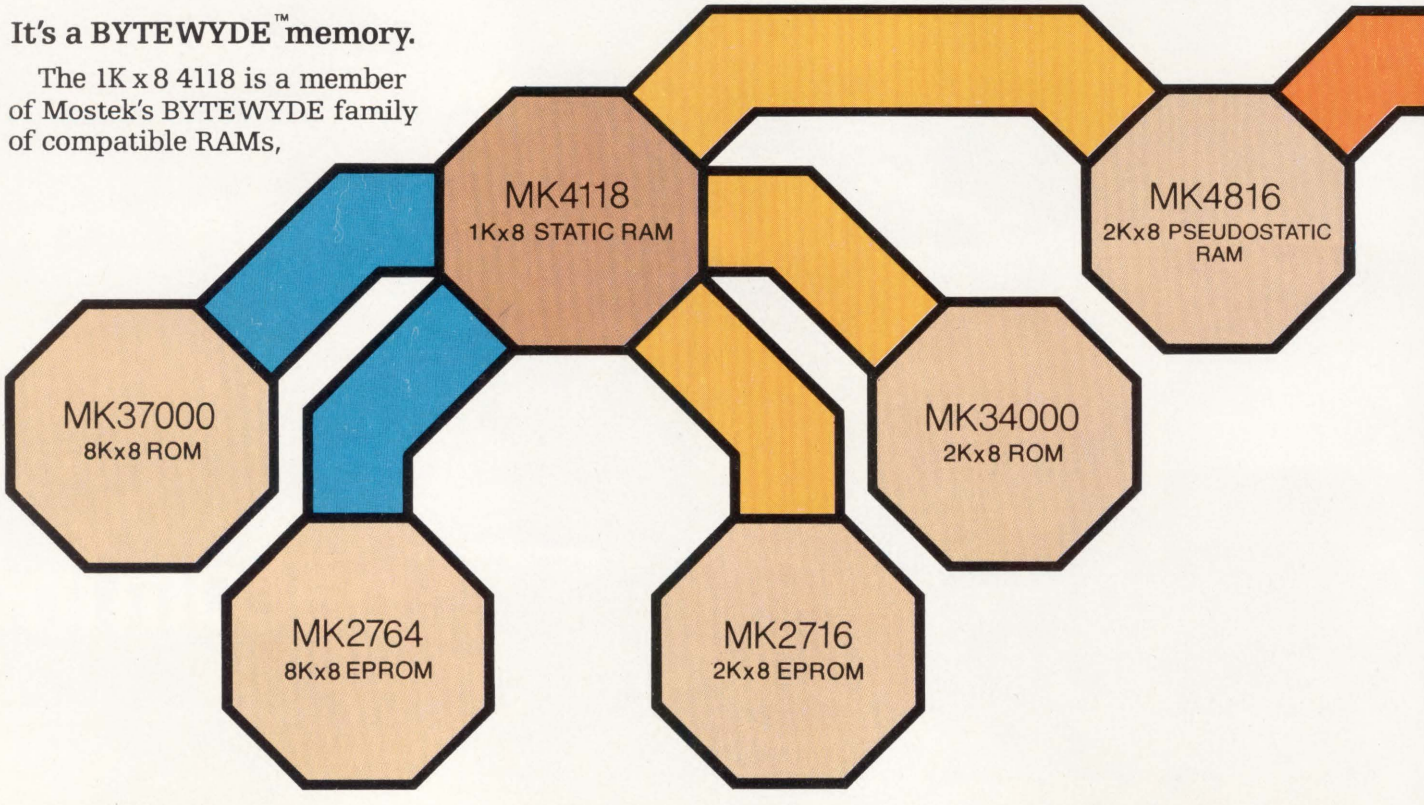
The 1K x 8 4118 is a member of Mostek's BYTEWYDE family of compatible RAMs, ROMs and EPROMs. These memories have a common pinout, so you can interchange all three types. And upgrade to next generation memories as well. Without redesign.

The coordinated design path concept of BYTEWYDE memories gives you flexibility, upgradeability and compatibility never before available. Consistent n-words x 8-bit organization makes these memories ideal for 8-bit and 16-bit microprocessor applications. By using them in building-block fashion, the design of a custom memory array is as easy as selecting and plugging in the circuits you need.

Compatible with ROMs and EPROMs.

The 4118 is housed in a 24-pin package and designed to fit a 28-pin P.C. board socket so you can interchange it with present and next generation ROMs and EPROMs. Including the widely accepted 2716 EPROM. That, in itself, opens up dramatic new opportunities for compact microprocessor memory.

To explain: At design time, the exact ratio of ROM/EPROM vs. RAM is rarely known. Also, changes in that ratio frequently occur during the product life. Without common pinout, you need to layout 2 matrices of



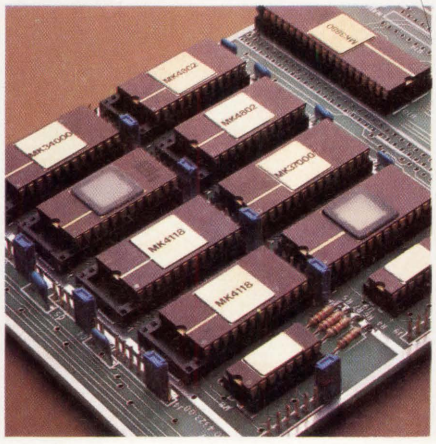
sockets (1 for ROM/EPROM and 1 for RAM) to accommodate any change in the ratio. That wastes real estate. With a common pinout, however, you only need 1 matrix of 28-pin sockets. That reduces space and headaches.

Compatible with next generation RAMs.

The coordinated packaging philosophy of the 4118 applies to density upgrades as well. In fact, with the 28-pin socket layout, upgrades to 32K x 8 can be made without redesign. Consequently, you can take advantage of technology advancements to increase density. And reduce cost without redesign.

Compatible with microprocessors.

Like other BYTEWYDE memories, the 4118 interfaces directly with all present and future generation microprocessors. An Output Enable control provides easy user control of the bus in all bus configurations. Two selection control functions (Chip Enable and Output Enable) are consistently provided for all BYTEWYDE memories to avoid bus contention problems.



Give yourself a choice.

Before you select your next memory components, consider the design path implications associated with them. Can they be interchanged with other types? Or upgraded through several generations without redesign? If not, you owe it to your design to evaluate Mostek's BYTEWYDE memories. To find out more, call or write: Mostek, 1215 W. Crosby Rd., Carrollton, Texas 75006, (214) 323-6000. In Europe, contact Mostek Brussels at 660.69.24.

MOSTEK®

CIRCLE 34 ON INQUIRY CARD

MK4802
2Kx8 STATIC RAM

BYTEWYDE™ FAMILY PINOUTS

4118 4801	4802	34000	2716	4816	37000	2764		2764	37000	4816	2716	34000	4802	4118 4801
				$\overline{RFSH}$	NC	NC	1 28	VCC	VCC	VCC				
				NC	A12	A12	2 27	NC	NC	$\overline{WE}$				
A7	A7	A7	A7	A7	A7	A7	3(1) (24)26	NC	NC	CS	VCC	VCC	VCC	VCC
A6	A6	A6	A6	A6	A6	A6	4(2) (23)25	A8	A8	A8	A8	A8	A8	A8
A5	A5	A5	A5	A5	A5	A5	5(3) (22)24	A9	A9	A9	A9	A9	A9	A9
A4	A4	A4	A4	A4	A4	A4	6(4) (21)23	A11	A11	NC	VPP	NC	$\overline{WE}$	$\overline{WE}$
A3	A3	A3	A3	A3	A3	A3	7(5) (20)22	$\overline{OE}$/VPP	$\overline{OE}$	$\overline{OE}$	$\overline{OE}$	$\overline{OE}$	$\overline{OE}$	$\overline{OE}$
A2	A2	A2	A2	A2	A2	A2	8(6) (19)21	A10	A10	A10	A10	A10	A10	$\overline{L}$
A1	A1	A1	A1	A1	A1	A1	9(7) (18)20	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$	$\overline{CE}$
A0	A0	A0	A0	A0	A0	A0	10(8) (17)19	D7	D7	D7	D7	D7	D7	D7
D0	D0	D0	D0	D0	D0	D0	11(9) (16)18	D6	D6	D6	D6	D6	D6	D6
D1	D1	D1	D1	D1	D1	D1	12(10) (15)17	D5	D5	D5	D5	D5	D5	D5
D2	D2	D2	D2	D2	D2	D2	13(11) (14)16	D4	D4	D4	D4	D4	D4	D4
VSS	VSS	VSS	VSS	VSS	VSS	VSS	14(12) (13)15	D3	D3	D3	D3	D3	D3	D3

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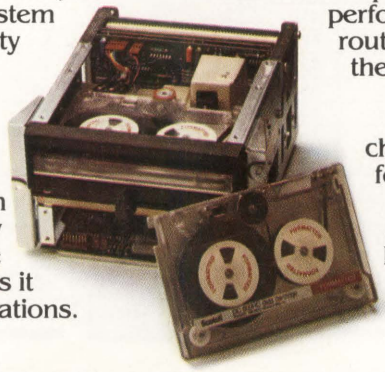
NEVER BEFORE HAS SOMETHING SO SMALL BEEN ABLE TO HOLD SO MUCH AT SUCH A LOW COST.



This is 3M's DC-600 HC Data Cartridge for disk back-up. It's just 4" x 6" x ½". Yet it holds a full 67 megabytes of formatted user information (144 megabytes unformatted). And most surprisingly, it only costs about thirty dollars.

The marvel that makes it work is our HCD-75 Data Cartridge Drive. At 4.6" x 7" x 8.6" (19" deep with controller/formatter module) it's the smallest full-capability back-up system available today. And its storage capacity makes it the most economical, too.

You see, the HCD-75 drive unit eliminates the need for costly multi-track heads. Instead, it uses a new tape head which features automatic positioning to any of the tape's sixteen tracks. The result is a storage capacity much larger than ever before possible with data cartridges. Which also makes it suitable for other mass storage applications.



Extensive use of microprocessors in the HCD-75 make it the world's first truly intelligent cartridge drive system. Other than initial commands, all tape drive functions are controlled locally. So the host computer system can remain free for other functions. What's more, the HCD-75 features sophisticated error detection and correction capabilities. And to insure system performance, self-test diagnostic routines run continuously. Even when the system is not in use.

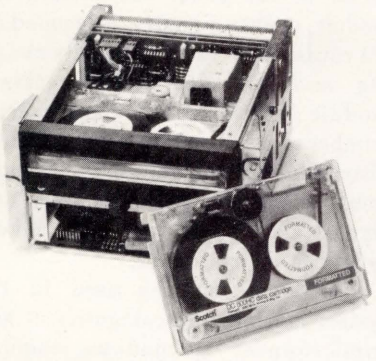
Will wonders never cease?

For more information, check the listing on the next page for the representative nearest you. Or write: Data Products Division/3M, Bldg. 223-5E/3M Center, St. Paul, MN 55144.

THE DISK BACK-UP SYSTEM THAT'S SUDDENLY WAY OUT FRONT.

CIRCLE 35 ON INQUIRY CARD

3M



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3M

by combination of straight shot, gravity feed, and pneumatic assist. An important feature for noncartridge reels is that leader is automatically sensed and fed to the threading channel.

An implementation unique to the company, the analog data bus interface allows for better noise margins, symmetry control, and single-point control function. The Z80 microprocessor and its 8k bytes of control store has permitted many functions previously committed to hardware to be supplied by firmware, reducing chip and card count. Among these functions are diagnostic capability as well as control timings and motion algorithms.

Tape control unit contains six independent functional elements connected with a microprocessor bus structure. These include a 1370 channel interface, read section, write section, tape unit interface section, control microprocessor, and 16k bytes of memory loaded from a floppy disc. This section manages the rest of the control unit but does not process read or write data. The write section uses a microsequencer and is capable of PE, GCR, and optional NRZI write operations. Read section contains all hardware necessary to detect, deformat, and correct PE, GCR, and optional NRZI read data.

Channel interface block contains a bipolar microsequencer to handle channel protocols. While this microsequencer does not process any read or write data, it does control communication between control unit and host central processor. This use of the microsequencer allows the control unit to perform inline maintenance and diagnostic activities while maintaining the integrity of channel communication.

The tape unit interface is architecturally designed to attach four tape units with optional extension to eight units in any mix of speeds and recording densities. This interface accomplishes attachment of control section of the microprocessor and independent read and write data paths to the attached tape units.

Provided in the maintenance facility are maintenance panel, mini-floppy disc, and maintenance port for connecting external devices. This facility accomplishes the man/machine interface to internal workings of the control unit. Operational microcode for the control unit's three internal microprocessors is stored on the floppy disc along with a patch track for each microcode. Also stored on the disc are the wake-up diagnostic routines, diagnostic monitor, and a log area for operational statistical data. The maintenance port allows local or remote connection of the 3910 intelligent terminal via an acoustic coupler.

Through the maintenance panel, an operator or field engineer can perform manual control functions including sensitive controls, operational status, data entry/execute, and remote maintenance. Sensitive control section allows an operator to take the subsystem offline, to reset, or to perform an initial program load of operational microcode. Error and status indicators on the panel reflect the operational state of the machine and provide initial fault indication. From the data entry panel, convenience functions can be invoked. These include initializing a new tape or searching a tape for a specific file. Prompting cards aid the operator in performing these functions. Remote maintenance mode can also be entered from this keypad.

Maintenance capabilities include the 3910, tape subsystem sensors, diagnostic hooks, diagnostic microprograms, maintenance panel, and buffered logs, and a remote company maintenance center. To perform local maintenance, a 3910 is attached to the system via the RS-232 interface, and functional, stress, and fault isolation diagnostics are run. For remote maintenance, the subsystem is attached via interface, modem, and telephone to 3910s located in the company maintenance center. The subsystem buffered log aids by maintaining a record of control and data errors, transferring this error data to the floppy disc. This information can be accessed either from the buffer or the floppy and error analysis can be performed.

Circle 420 on Inquiry Card

Automatic Test Equipment Employs Concept of Virtual Instrumentation

Automatic test equipment offers cost-effectiveness through implementation of the concept of virtual instrumentation. Manufactured by Marconi Space and Defence Systems Ltd, and distributed by Marconi Instruments Ltd, Longacres, St Albans, Hertfordshire AL4 0JN, England, the Graduate replaces conventional instruments and their functions with modules that operate under software control. These modules contain in printed circuit form, stimulus and measurement facilities that meet specific test requirements.

Benefits derived from the concept are elimination of obvious redundancies such as knobs, displays, and meters, the identification and isolation of specific functions that are common to many instruments but can be performed by a single module under software control, and automatic reconfigurability on instruction from the computer. This removes all redundancies and associated problems of unreliability, high cost, and space requirements associated with conventional techniques.

Major structural elements of the system are a kernel which is the basic module housing and a standardized 19″ (48-cm) instrument rack, which houses the main system control and failure monitoring panel and the dual floppy disc unit. This rack also accommodates any conventional instrument specified by the user. Operational control is carried out through a standard keyboard and visual display unit.

Variable architecture of the digital test unit accommodates specific characteristics and throughput of the unit under test. In contrast to fixed architecture machines, the system provides the user with a variety of test techniques and diagnostic methods. Available drive and response techniques offer signature analysis/transition correcting, logic simulation, and functional testing. These techniques can be mixed within individual test programs.

Unit under test pins can be driven from either hardware generators or backing store. Hardware generators provide pseudo-random bit patterns, clock signals, or pulse trains. The UUT response relies on comparison with known-good board or with a stored response.

The system achieves comparison with a known-good board by driving and sensing two sets of UUT pins and providing hardware comparators to detect inconsistencies as they arise. For diagnostic purposes IC chips and probes enable step by step comparison at any accessible point on the UUT. Stored response can be in three forms: post-processed logic simulation output, test engineer generated functional output patterns, or compressed data signatures that are generated by the initial measurement of a known-good unit.

The DUT is expandable in 32-pin blocks up to 256 pins. Each pin is backed by 8k of RAM. Test patterns can be applied to the UUT at a maximum rate of 10M/s. Standard pin electronics provide for testing TTL, MOS, and CMOS devices; 3-state devices can be accommodated. Optional facilities extend voltage levels to testing of ECL and other logic devices.

Central control of the system is exercised by a 24-bit word microprocessor based controller, housed in a double module and occupying a fixed location in the kernel. Main memory uses 16k dynamic RAMs and expands in 32k-word increments up to 256k words.

A separate peripheral control module contains the system's highway controller, IEEE interface, and both parallel and serial interface channels for the standard display, keyboard, and printer.

Provision is made within the kernel for an expansion interface module which accommodates further peripherals. System floppy disc drives interface directly into the controller peripheral highway. Parallel interfaces are microprogrammable to accept various mixes of peripherals.

Circulated to each kernel shelf, the highway control bus is also available through the UUT interface for UUT adapter control. At each shelf, a buffer carries out primary address decoding and drives a secondary bus to each module location, using the same connector as the power bus. Within the module, control signals are decoded on IPA cards which carry out parity checking and provide error checking, module identification, and serial number and calibration data. IPA cards distribute control and data to functional elements of the module and signal error detection and power failure to the controller.

Functional modules used in the system fall into two categories: lf and ir/microwave. lf modules include digital voltmeter with optional ac and ohm facilities, and sampling facility for amplitude measurements below 20 Hz; fast comparator that sets trigger threshold levels for time measurements on waveforms; function generator that provides sine, square, and triangular waveforms; programmable gain module used to normalize signals in 10-mV to 100-V range into 2.5- to 10-V range; and precision voltage source that provides 0 to 20 Vdc in 5-mV steps and 0 to 100 mA in 1-mA steps. The selective waveform assembly network combines up to four waveforms and includes programmable attenuation stage. Universal counter timer provides frequency, time interval average, period, period average, and totalizing functions up to 50 MHz; universal timer supplies programmable time generation facilities for up to three independent channels and can handle up to 128 individual channels. Functions of rf modules include noise figure, and modulation index meters, programmable frequency and programmable leveler attenuator modules, and a programmable amplifier.

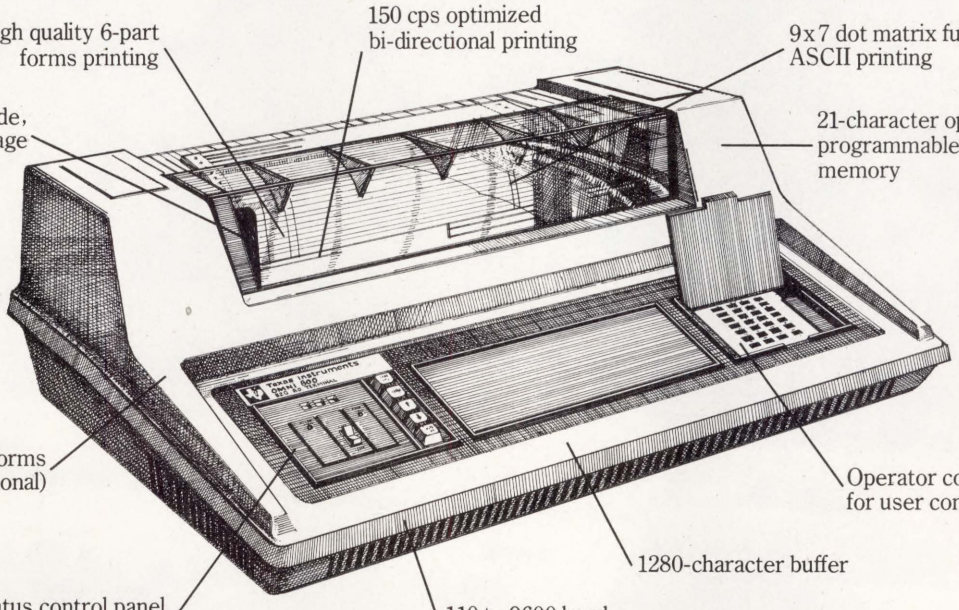
The system uses MSDS CLIMATE software. This software presents a display of individual functional modules or virtual instrument combinations together with necessary structuring processes. Thus the test engineer can select facilities required and the software will create syntactically and semantically correct programs in the required test language. An offline program preparation station provides all facilities for writing, debugging, and verifying test programs. This station generates programs that are transferrable on floppy discs to test systems.

Circle 421 on Inquiry Card

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TI is dedicated to producing quality, innovative products like the Model 820 Receive-Only Printer. TI's hundreds of thousands of data terminals shipped worldwide are backed by the technology and reliability that come from 50 years of experience, and are supported by our worldwide organization of factory-trained sales and service representatives.

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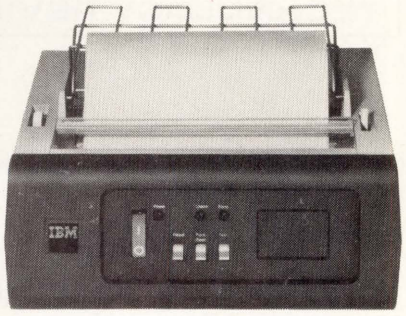
Out of the carton and into operation

When the 3101 arrives, you simply connect three modular elements – the display, the logic element and the keyboard – plug it in, position the setup switches and put it into operation. It takes just a few minutes. The 3101 weighs 38 pounds so you can move it easily.

Human engineering inside and out



The 12-inch diagonal screen can be swiveled and tilted to cut interference from overhead lighting. It displays a maximum of 1,920 characters in 24 lines. You can select green characters on a black background or black on green. And there's a detachable contrast-enhancing filter to reduce glare.



A low-cost printer, too

You can couple our 3102 printer to the 3101. You'll have the double convenience of displaying all your information, while capturing a hard copy of the data being displayed. The 3102 printer is lightweight and priced at just $1,295.

Selected specifications and prices

There are two 3101 configurations: character transmission and block transmission. Character transmission lets you use it like a teletypewriter. Block transmission provides sophisticated editing capabilities, such as insert/delete and full cursor control, along with field functions like blinking, high intensity and protected fields. Both models can generate all 128 ASCII codes.

Accessible setup switches in the keyboard let you select functions such as line speed, parity, scroll and reverse video. The movable keyboard is much like the IBM Selectric.(TM)

The prices for the display terminal start at $1,295 for the character transmission model, and $1,495 for the block model. Volume procurements can save you up to twenty percent for either configuration of the terminal. Prices and current schedules subject to change.

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CD580

CIRCLE 96 ON INQUIRY CARD

Wide Beltbed Plotter Offers Economical Alternative To Flatbed Units

A wide 4-color beltbed plotter, the model 960 provides all capabilities of a large flatbed unit at 25 to 50% lower cost. This low cost alternative to flatbed plotters from California Computer Products, Inc, 2411 W LaPalma Ave, Anaheim, CA 92801 is made possible by the inherently less expensive beltbed design.

Distinguished by its vertical plotting surface, the unit operates much like a drum, and has essentially the same plotting precision and speed, but offers the plot size of a flatbed. The design of the unit is such that manufacturing tolerances are easier to maintain, holding costs down, while supplying the user equivalent performance. Like a drum, it moves the paper under the pen as well as the pen over the paper. Like a flatbed, however, it plots on cut sheets of paper up to 52″ (132-cm) wide and 80″ (203-cm) long, that are taped to a Mylar belt running between the drum and the idler roller.

Operating at up to 30 in (76 cm)/s with a 2G acceleration, the unit has drawing resolution of 0.00049″ (0.01245 mm). Four pens allow multiple-color plotting as well as multiple-line widths. The system operates in online, offline, and remote timesharing environments at speeds up to 9600 baud, and interfaces to most minicomputers and mainframes. The software required is the same as that for drum plotters.

Floor space requirements of the system total 12.6 sq ft (1.2 m^2) providing a substantial savings over flatbed units. Pushbutton control panels located on the front of the unit provide convenience factors such as electronic limit capability, return to last plotted position, and plot time meter. A self-test feature aids in troubleshooting the device when required. An interlocked transparent safety shield protects the operator from the pen carriage during acceleration and operation. Y-axis limit switches keep the pens within the perimeters of the belt.

Priced at under $51,000 complete with interface for minicomputer or mainframe, the unit is targeted at applications in computer aided design and drafting within interactive graphics systems.

Circle 422 on Inquiry Card
See at Booth 2629

IBM-Compatible Medium Scale Computers Offer High Reliability

Aimed at the low and middle portions of the IBM compatible computer market, the medium scale AS/3000 series offers performance equivalent to the IBM 4341 on the low end and to the System/370 model 158-3 on the high end. Members of the family, being offered by National Advanced Systems, 3145 Porter Dr, Palo Alto, CA 94304 and manufactured by National Semiconductor's Computer Products Group, include the AS/3000N, a 2M- to 4M-byte, 5-channel processor and the AS/3000, a 2M- to 8M-byte, 5-channel processor.

The AS/3000N, an entry level system, provides performance equivalent to the IBM 4331 and from 1.4 to 1.6 times that of the System/370 model 148. This unit is characterized by capability to perform 0.75M instructions/s with a machine cycle time of 115 ns and memory cycle time of 690 to 920 ns. It provides an 8k cache, and is field upgradable to the /3000. The /3000 improves performance of the /3000N by 20 to 30% and provides performance equivalent to a System/370 model 158-3. With 115-ns machine cycle time and 690- to 920-ns memory cycle time, the /3000 performs 0.9M instructions/s. Cache size is 16k. Both systems support all current releases of DOS/VSE, VS/1, MVS, VM/370, DOS, and OS operating systems.

Price of the /3000N in its basic configuration is $325,000. The /3000 costs $425,000. Prices include applicable IBM compatible firmware assists. Add-on memory is priced at $50,000/megabyte.

Circle 423 on Inquiry Card

IC Holder/Socket Eases Insertion of Components Onto Boards

Making nonerasable memory devices easy to insert and withdraw from printed circuit boards, low cost IC holder and socket are keyed to each other to prevent misalignment of IC or socket pins. Developed by Molex Inc, 2222 Wellington Ct, Lisle, IL 60532, the custom made assembly mates with a microprocessor and 16-character alphanumeric display.

In its present form, a 24-pin IC is inserted upside down into the holder and the pins are folded to secure the IC. The holder is then inserted into or withdrawn from the socket by means of a small handle on top of the holder. Insertion and withdrawal force is less than 5 lb (2 kg).

Holder and socket base is molded nylon with 15% glass. Socket contacts are tin-plated brass in a folded leaf arrangement for DIP devices with 0.600″ (15.24-mm) spacing between pin rows and 0.100″ (2.54-mm) spacing between pins on the same row. The actual socket requires 0.800″ (20.32-mm) spacing between rows.

The socket stands 0.390″ (9.906-mm) off the surface of the board. The holder/chip carrier sits entirely within the socket, except for the handle which rises an additional 0.108″ (2.743 mm) above the socket. The chip carrier, in future configurations, may accommodate 28-, 40-, or 48-pin devices in DIP configurations.

Circle 424 on Inquiry Card

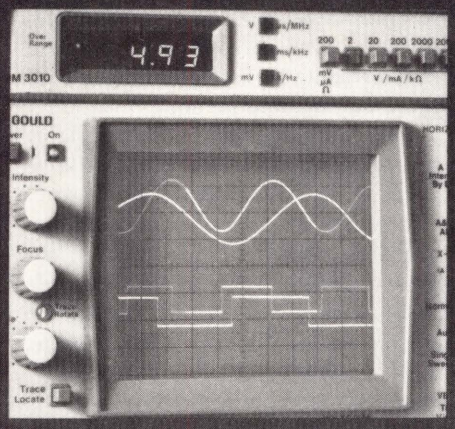
Now—Gould quality in a 100 MHz oscilloscope.

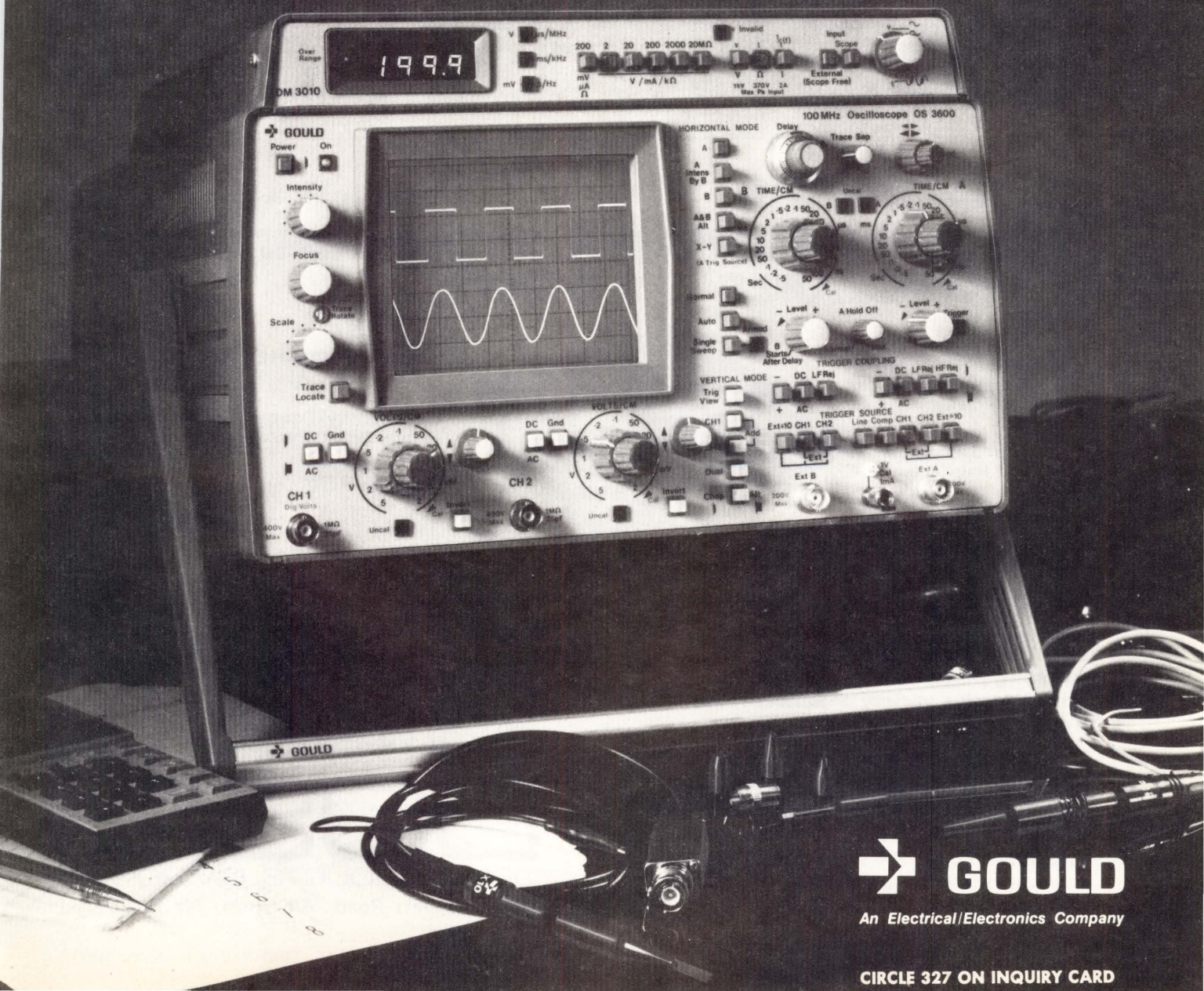
No scope on the market has more of the features you need than the new Gould OS3600 with optional DMM. You can use the OS3600 on any electrical/electronic circuit from digital to conventional with exceptional results.

With vertical sensitivity of 2mV/cm up to 85 MHz, the OS3600 can examine extremely low level signals. The 4-trace capability allows comparison of original and delayed sweeps.

The bright, flicker-free CRT displays even narrow pulses with low repetition rates. The optional 3½ digit DMM is available as a factory fit or retrofit. Plus, the OS3600 is backed by a worldwide service network and a unique 2-year warranty that covers all parts and labor (exclusive of fuses, calibration, or minor maintenance).

Write Gould Inc., Instruments Division, 3631 Perkins Avenue, Cleveland, OH 44114. Call toll free 800-331-1000 (in Oklahoma, call collect 918-664-8300).





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An Electrical/Electronics Company

CIRCLE 327 ON INQUIRY CARD

Counter/Timers Offer Keyboard Control, 9-Digit Resolution

Series 9000A counter/timers upgrade IEEE Std 488 bus performance of their predecessors, the series 9000, and improve operator convenience. In the instruments, Racal-Dana Instruments Inc, 18912 Von Karman Ave, Irvine, CA 92713 has used a new 8-bit microcomputer to provide faster control, keyboard routines for operator feedback, memory routines for recall of stored constants, and a GPIB IEEE 488 interface with 10 times previous speed.

Calculator type keyboards on the units serve for function control rather than traditional knobs, buttons, or switches. LED displays used as status indicators give total annunciation of controls status. In addition to the 11-digit readout, two 3-digit readouts continuously display trigger level settings for both channel A and B. Because the unit is microprocessor controlled, measurements can be made with the touch of a button. The counter then automatically selects the appropriate gate time or multiplier for a quick reading. Resolution can be selected through a single keyboard entry. For frequency and period measurements both voltage range and trigger level can be automatically set to minimize measurement errors. Pulse parameter can be determined automatically by selection of one of three pushbuttons.

Full 9-digit resolution is available for most measurement situations. Calculating capability allows the instrument to be used as universal timer/counter, reciprocating counter, or preset counter. All models provide measurement capability to 100 MHz: frequency, period, period average, time interval, time interval average, frequency ratio, and totalize.

Because of its high speed, the unit operates in burst or armed mode instead of taking readings continuously. If the frequency of a burst is to be measured, it waits until the burst is detected, then takes a reading. Its 3-μs setup time permits 4-μs bursts to be measured.

Keyboard entry and integral microprocessor permit measurements to be scaled, biased, or inverted to supply direct readout in other engineering units.

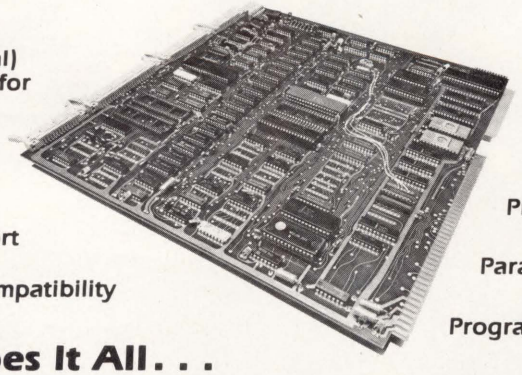
To simplify connection of instrumentation the GPIB meets all IEEE Std 488 specifications and can be connected to any other instrument equipped with the bus. For systems applications requiring high speed data transfer rates, the high speed computer interface provides a parallel bit format to maximize the data transfer rate. Basic interface structure consists of 5 control lines, 16 input lines, and 47 output lines. Numeric output is BCD coded with all inputs and outputs compatible with TTL levels.

The series is available in four models (9015A, 9035A, 9015/11A, and 9035/11A) with frequency ranges from dc to 512 MHz, depending on model. Prices range from $2995 to $4295 for basic units. Circle 425 on Inquiry Card

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The TCB-85 uses the Intel 8085A CPU and can optionally be ordered with the Intel 8085A-2/10 MHz CPU.

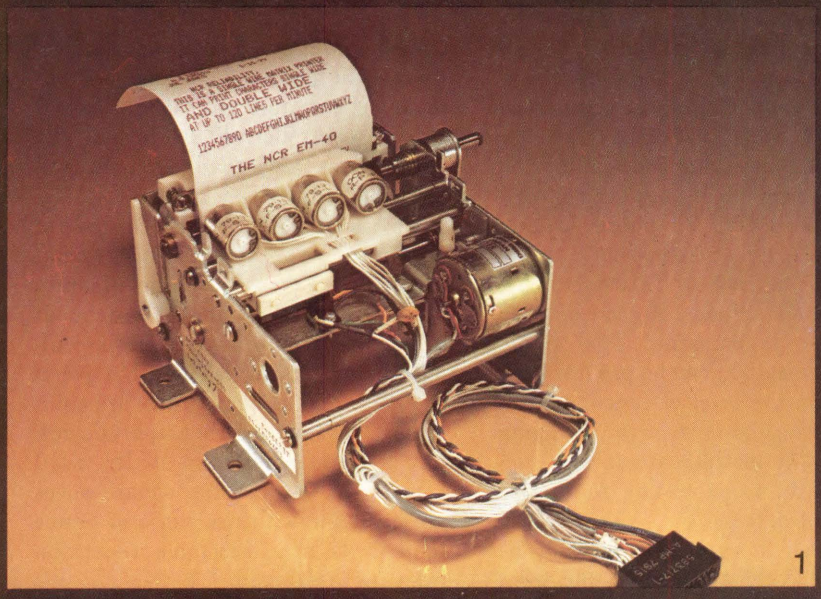
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Evaluation units are now available for immediate delivery and priced at just $1275 in quantities of 100.

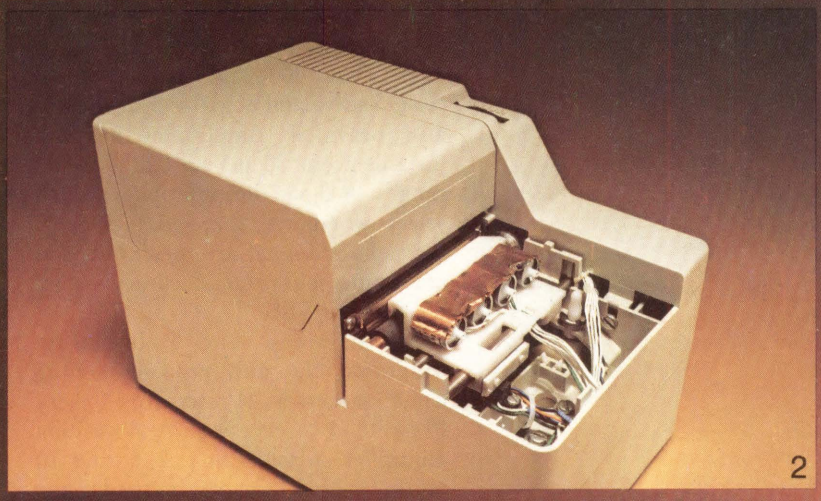
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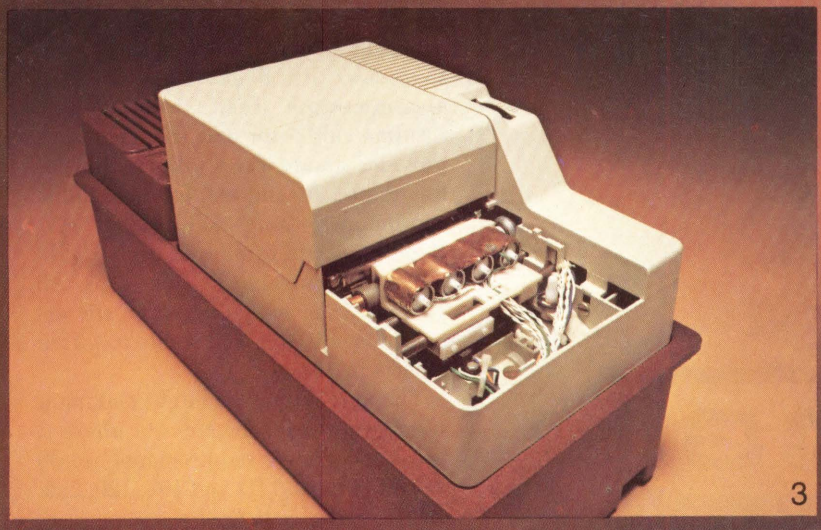
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CIRCLE 328 ON INQUIRY CARD

Take your pick.

Programmable Time And Amplitude Test Set Offers IEEE Bus Compatibility

Model 6125C-Option 60 is a versatile, portable instrument for precision calibration of oscilloscopes up to 500 MHz, digital frequency counters, spectrum analyzers, and basic voltmeters. In the instrument, Ballantine Laboratories, Inc, PO Box 97, Boonton, NJ 07005, has provided full talker/listener operation of all programmable controls by means of the IEEE Std 488-1978 interface bus. The unit may also be operated manually.

Other capabilities of the instrument include ability to accomplish voltage calibration, main and delayed sweep calibration, risetime calibration, frequency calibration, and related measurements. Its IEEE interface permits easy connection to automatic test equipment and calibration systems. When used for oscilloscope calibration it can save significant test time and expense because of its speed in programmed automatic checkout.

Controllers such as Tektronix 4051, HP 9825, and Wang 220, can be used with the instrument. The scope calibration system can be programmed to provide the level of function, data logging, display, or error flagging needed. The instrument can be structured to do scope testing to various degrees of detail.

Although the unit will normally be operated as an ATE system, the front panel is designed for facile man-machine interface. LED displays inform the user of the function, range, marker mode, or deviation error being applied by the controller. Panel layout and legends are easy to understand and knobs are widely spaced.

No calculations are necessary to determine whether an instrument under test is within specification limits. The 3½-digit LED readout displays any error directly in percentage giving a resolution of 0.01% over a ±10% range. Other features are ability to select square wave amplitude output at frequencies from 10 Hz to 10 kHz in decade steps; fast square waves are available with rise times of better than 1 ns and selectable repetition rates from 100 ns to 1 s.

As a voltage calibrator, the test set provides crystal derived square waves at 10-, 100-, 1000-, and 10k-Hz frequencies; positive and negative dc levels are also provided. Amplitudes are adjustable from 30 mV to 220 V in 20 ranges. A 9-position multiplier switch selects whether 1, 2, 3, 4, 5, 6, 8, or 10 divisions of signal are displayed, and amplitude calibration accuracy is better than ±0.25%.

As a sweep and delay time calibrator, the unit provides timing comb markers at 24 rates from 1 every 2 ns to 1 every 5 s. A 4-position multiplier switch with 1, 2, 5, and 10 multiplication factors extends the maximum interval to 50 s. The timing calibrator provides 200- and 500-MHz sine waves with 5- and 2-ns periods to accommodate fast sweeps. The risetime calibrator and trigger output provides square waves with rise time of less than 1 ns and amplitude variable continuously from 200 to 250 mV. Repetition rate can be set from 0.1 Hz to 10 MHz in nine decade steps. All generated ac signal outputs are accurate to ±0.01% and stable to within 3 parts in 10^7/day.

The unit is small and light making it suitable for transportation to where it is needed. Power requirements are 30 W and 50 to 400 Hz and 100, 120, 220, or 240 V rms ±10%.

Circle 428 on Inquiry Card

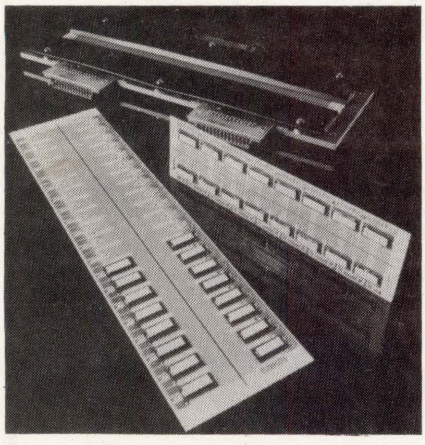


Thick Film Thermal Printheads Incorporate All Circuits on Substrate

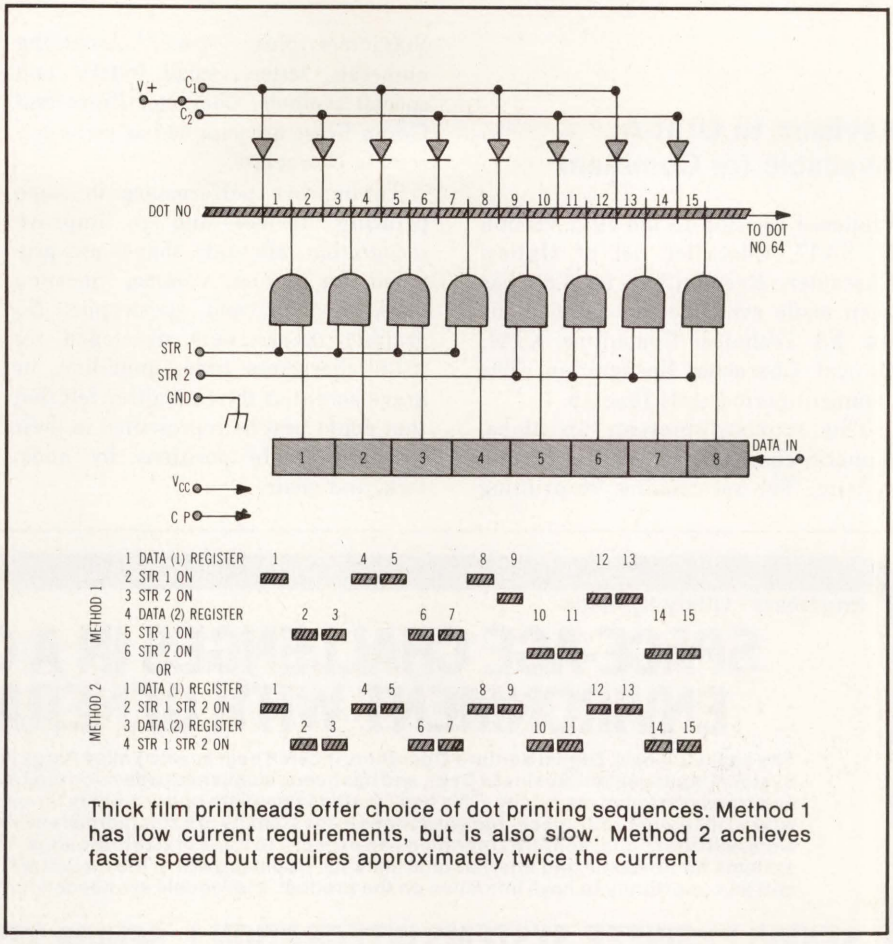
Solid state thick film thermal printheads that incorporate all circuitry on the substrate display dramatic improvements in printhead reliability and print quality. Developed by R-Ohm Corp, PO Box 19515, Irving, CA 92713, printheads using the technology can be supplied with single element print widths up to 10″ (25 cm), can achieve line speeds of 2 ms, and can increase dot density to 8 dots/mm. Both graphics and alphanumerics can be produced with the same head.

Significant improvements in thick film and ceramic technologies used in the printheads, coupled with the mounting of all required circuitry directly on the substrate are responsible for the improvements. The construction technique as well as elimination of external drivers, diode matrices, shift registers, and associated cabling improves reliability and head life such that a minimum MDLBF of 100 x 10^6 is guaranteed. To achieve this result, it was necessary to totally control each ingredient. Screening of paste, composition of substrate, characteristics of ICs and diodes as well as mechanical aspects of the carrier have all been carefully integrated in the printheads.

Typical is the KH101, a 5″ (12-cm) 4-dot/mm printhead using a single bar heating element. Dot size is 0.007 x 0.0118″ (0.18 x 0.3 mm) and print speed is 80 ms/line. The unit produces 511 dots using an IIL 32-bit driver circuit. All enabling electronics are mounted on the printhead in 40-pin IC flatpacks, simplifying interfacing and contributing to reliability and long life.



Solid state thick film printheads developed by R-Ohm can print widths up to 10″ and provide speeds of 2 ms/line. By mounting all required circuitry directly on substrate, improvements are attained in reliability and head life



Thick film printheads offer choice of dot printing sequences. Method 1 has low current requirements, but is also slow. Method 2 achieves faster speed but requires approximately twice the currrent

The KH102 is an 8.3″ (21 cm), 6-dot/mm printhead. Each dot in the 1-piece heating element can be used to create numerals, characters, lines, and solids of the desired width, size, and density. Capable of producing 1279 dots, each 0.0041 x 0.0137″ (0.105 x 0.35 mm), the unit operates at 4-ms/line print speed.

Mounting directly to the printhead substrate, the BA8202 converts a multiplexed serial data input stream to the required parallel dot command. The 32-bit IIL driver requires fewer than 20 connections to the head. Input data are clocked into shift registers (200-kHz maximum clock frequency) whose outputs are 32- or 64-bit IIL drivers, which are then strobed to heat the appropriate dot element.

The dot printing sequence is selected in accordance with the diagram. As in method 1 input data with Common 1 on and STR 1 on causes dot numbers 1, 4, 5, and 8 to heat. With STR 2 on, dot numbers 9, 12, and 13 heat. Shifting to Common 2 with STR 1 on causes dots 2, 3, 6, and 7 to print, while with STR 2 on, numbers 10, 11, 14, and 15 are printed. While using twice the current, method 2 is also faster. In this method STR 1 and STR 2 on simultaneously causes dots 1, 4, 5, 8, 9, 12, and 13 to heat; shifting to Common 2 in this case causes numbers 2, 3, 6, 7, 10, 11, 14, and 15 to print. In the case of KH101 each strobe is capable of driving 16 dots and up to 8 blocks, with the KH102 each strobe can drive 64 dots and as many as 10 blocks.

The KH-100 series is offered in standard print widths of 2, 5, 8 and 10″ (5, 12, 20, and 25 cm). Dot densities range from 3, 4, 6, to 8 dots/mm.

Circle 429 on Inquiry Card

Revision to OCR-A Available for Comment

Proposed revision to the 1977 version of X3.17, Character Set of Optical Character Recognition (OCR-A) has been made available for comment by the X3 Technical Committee X3A1, Optical Character Recognition. The comment period ends June 15.

This standard presents an alphanumeric character set for use in OCR systems. The set contains 96 printing characters plus "space," including numerals, letters, small letters, and special symbols. Character Erase and Group Erase are supplied as error correcting characters.

To improve performance in some printing devices and to improve recognition, alternate shapes are provided for period, comma, question mark, hyphen, and apostrophe. No graphic shapes were developed for ASCII characters tilde, underline, or grave accent as the committee felt that they could best be represented in their respective code positions by hook, fork, and chair.

Character set repertoire and shape specifications in this standard are identical to those contained in American National Standard Character Set and Print Quality for Optical Character Recognition (OCR-A) X3.17-1977. This standard, containing only character shapes and nominal positions is a refinement of and supercedes X3.17-1977.

Copies of the draft are available from the X3 Secretariat, CBEMA, 1828 L St, NW, Suite 1200, Washington, DC 20036. Each order must include a check for $6.50 and a self-addressed mailing label.

Engineers - Utility Systems

SPACE-AGE CHALLENGES IN A COMMERCIAL ENVIRONMENT WITH GENERAL ELECTRIC

The spanking new, Digital Venture Operation, located near scenic Valley Forge National Park, is a part of G.E.'s Power Systems Management Business Dept. and has been established to develop digital systems as applied to the distribution and transmission of electricity. This has created immediate opportunities for experienced engineering professionals who wish to work with space-age challenges in the stability of a commercial environment. Those individuals selected to work with the Digital Venture Operation can expect it to triple in size in the short-range future. They will work with utility systems for domestic and international markets. Rapid growth in the market will result in high visibility for promotion and an opportunity to have influence on the product. Individuals are needed for the following positions:

SENIOR ENGINEER, SYSTEMS INTEGRATION

This position involves defining and documenting all system and subsystem interfaces for both internal utilization by GE and contract definition to the customer. You will lead negotiations with customer representatives on matters regarding interfaces with the electric utility system; lead design review of hardware and software implementations to assure compliance with contractural obligations; and support Marketing and Product Planning in maintaining structured modular product lines. In-depth technical knowledge and broad experience in hardware, software and power systems is required, as is the ability to successfully interface with a variety of professionals and customer representatives.

SENIOR DIGITAL SYSTEMS ENGINEER

Responsibilities will involve leadership in systems engineering for the design and development of a series of digital product lines for protection control, and monitoring of transmission and distribution systems. You will also support Marketing, Product Planning and Application Engineering in the generation of product definitions; establish candidate system architectures; perform hardware/software tradeoffs; and formulate computing strategies to accomplish various functional requirements. Extremely high technical expertise and experience levels are mandatory for this position.

EMI/ESI SPECIALIST

Experience with transient and steady state phenomena in both near and far field regions, and proven abilities in technical negotiations are required for this multi-faceted position. Responsibilities involve the definition of EMI/ESI requirements for the digital product lines for both transmission and distribution applications. You will define EMI/ESI testing to be consistent with present standards, identify and procure capital equipment required to conduct tests. In addition, you will represent the department in IEEE, FCC and other industry standards workshops, and liaison with other General Electric departments to verify thoroughness of design.

SENIOR TEST ENGINEER

This position will establish test requirements for both the transmission and distribution digital product lines, encompassing both prototype and production systems and include in-process, unit, subsystem, and system testing. Responsibilities also include the creation of purchase specifications for capital test equipment procurements consistent with test needs. The individual we seek must have an extremely high level of experience in the formulation of comprehensive and efficient test plans.

SENIOR LOGISTICS SYSTEMS ENGINEER

Effective written and verbal communication skills, and the ability to interface with a variety of individuals in multi-disciplined areas are mandatory requirements for this position. You will direct others in implementing the integrated logistics program for both transmission and distribution digital product lines. Responsibilities include the establishment of guidelines and procedures for management approval; and providing technical leadership and expertise to support Marketing, Product Planning and Application Engineering to obtain customer review/acceptance of the maintenance/sparing philosophy.

These highly technical positions require degreed individuals with an exemplary record of experience and expertise in the field. You will be rewarded with an outstanding salary and an attractive comprehensive company-paid benefits package. For immediate consideration, send your resume to:

Saul Waldman, Manager Recruiting

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ROLM's Mil-Spec ECLIPSE® Computers now have a software/hardware combination that zeroes in on today's tough, real-time military applications.

The total package is fast, compact, and configurable. A real-time operating system designed for both time-critical and hostile environments.

ARTS (Advanced Real-Time System) expands the performance range of our Mil-Spec ECLIPSE line of computers by adding true real-time multiprogramming, multitasking capability. WCS (Writable Control Store) provides the additional hardware to access our microprogrammed processor and increase throughput for high-speed applications.

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So let us show you the model that's right for you. Simply contact your Tektronix Sales Engineer. He'll arrange for a demonstration of our portable or laboratory oscilloscopes. And for our latest portable oscilloscopes brochure, write: Tektronix, Inc., P.O. Box 1700, Beaverton, OR 97075. In Europe: Tektronix International Inc., European Marketing Centre, Postbox 827, 1180 Av Amstelveen, The Netherlands.

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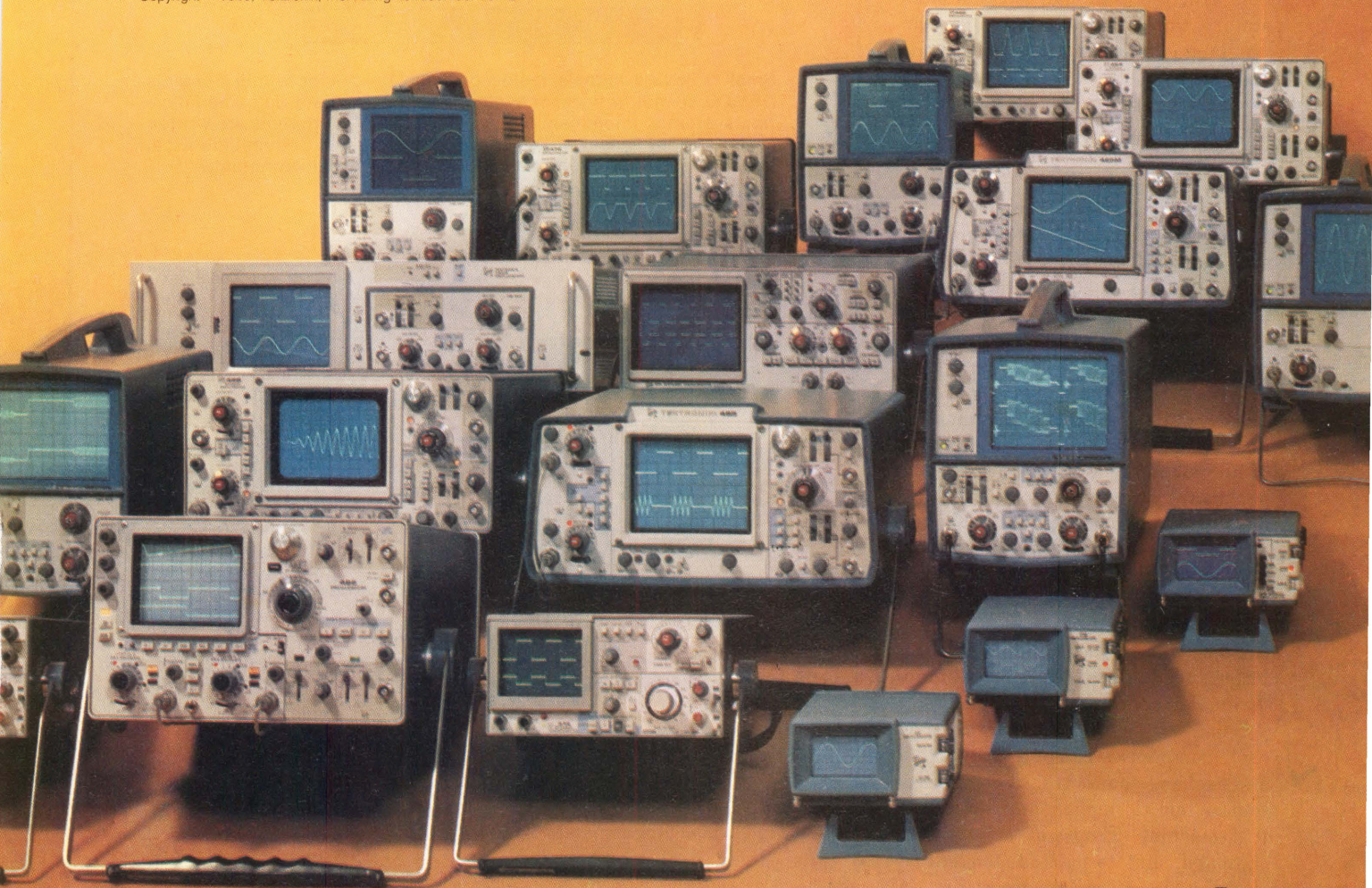


scope meets

	Product	Bw	Dual Trace	Delayed Sweep	Fastest Sweep Rate	Other Special Features
Storage Models	466	100 MHz @ 5 mV/div	yes	yes	5 ns/div	3000 div/μs stored writing speed
	464	100 MHz @ 5 mV/div	yes	yes	5 ns/div	110 div/μs stored writing speed
	434	25 MHz @ 10 mV/div	yes		20 ns/div	Split-screen storage
	314	10 MHz @ 1 mV/div	yes		100 ns/div	Only 10.5 lbs (4.8 kg)
	214	500 kHz @ 10 mV/div	yes		1 μs/div	Only 3.5 lbs (1.6 kg)
	T912	10 MHz @ 2 mV/div	yes		50 ns/div	Low-cost bistable storage
Nonstorage Models	485	350 MHz @ 5 mV/div	yes	yes	1 ns/div	Widest bw in a portable
	475A	250 MHz @ 5 mV/div	yes	yes	1 ns/div	High-performance 250-MHz portable
	475	200 MHz @ 2 mV/div	yes	yes	1 ns/div	Highest gain-bw in a portable
	465B	100 MHz @ 5 mV/div	yes	yes	2 ns/div	Cost effective for 100-MHz bw
	465M	100 MHz @ 5 mV/div	yes	yes	5 ns/div	Triservice standard 100-MHz scope
	455	50 MHz @ 5 mV/div	yes	yes	5 ns/div	Cost effective for 50-MHz bw
	335	35 MHz @ 10 mV/div	yes	yes	20 ns/div	Only 10.5 lbs (4.8 kg)
	305	5 MHz @ 5 mV/div	yes		0.1 μs/div	Autoranging DMM
	221	5 MHz @ 5 mV/div			100 ns/div	Only 3.5 lbs (1.6 kg)
	213	1 MHz @ 20 mV/div			400 ns/div	DMM/Oscilloscope @ 3.7 lbs (1.7 kg)
	212	500 kHz @ 10 mV/div	yes		1 μs/div	Low cost for dual trace & battery
	T935A	35 MHz @ 2 mV/div	yes	yes	10 ns/div	Variable trigger-holdoff and differential
	T932A	35 MHz @ 2 mV/div	yes		10 ns/div	Delayed sweep and differential
	T922	15 MHz @ 2mV/div	yes		20 ns/div	Low-cost dual-trace scope
	T922R	15 MHz @ 2mV/div	yes		20 ns/div	Rackmount version of T922
	T921	15 MHz @ 2mV/div			20 ns/div	Lowest-cost TEKTRONIX Portable
Time Interval Readout	DM44	Optional, factory-installed, direct numerical readout of time intervals and DMM functions for the 464, 465B, 466, 475, 475A				

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SOFTWARE

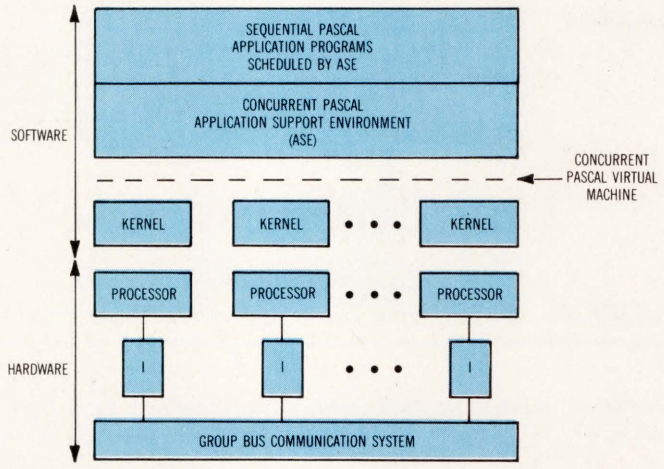
Software Concept Offers Integrated Approach To Multiprocessor Design

DEMOS software technology implemented by Scicon Consultancy International Ltd, Sanderson House, 49-57 Berners St, London W1P 4AQ has been chosen by the European Space Agency to program its multiple processor reconfiguration simulator. Connecting up to 32 computers, it will be used in simulation of satellite subsystems and space experiments and is part of a research project investigating parallel computing techniques.

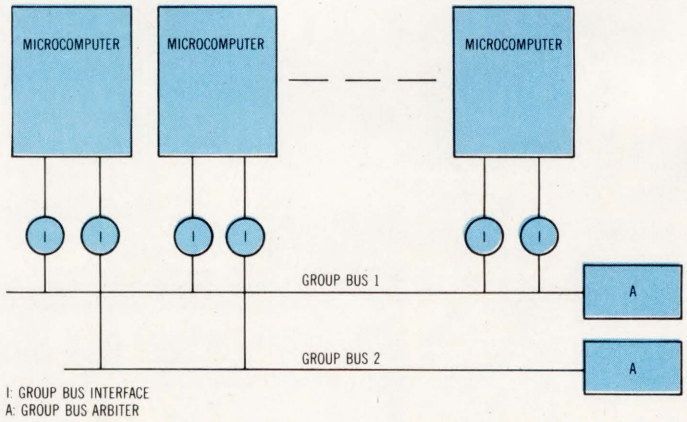
Originally developed in collaboration with the National Physical Laboratory, the ESA version will allow the simulator to be programmed in the high level concurrent Pascal language as if it were a single machine, and applications programs will be written in sequential Pascal. Programs developed for the initial system will run on larger configurations without change.

Key features of the DEMOS approach are its multicomputer architecture, single virtual machine, high level language, and independent system generation. The architecture enables each processor in the system to have its own private store that is inaccessible to other processors. Communication is through a high bandwidth data communication system connected as a peripheral to each processor. Other peripherals are connected in orthodox fashion to individual processors. This approach avoids the need for complex address mapping hardware and allows use of standard unmodified processors. Only the communications interface need be designed to suit the individual processor.

Small software kernels that reside on each component computer cooperate and exchange data via the communication system to implement a single virtual machine. Programs are written, compiled, and tested independent of the hardware configuration. A separate system generation facility allocates parts of the compiled pro-



Small software kernels reside on each processor within Scicon's DEMOS 86 multiprocessor system, exchanging data via communication system to implement single virtual machine. Kernels are written in Concurrent Pascal while applications written in Sequential Pascal are controlled at runtime by underlying support environment



Each computer in DEMOS system has interface which transfers blocks of data directly between store and 16-bit wide Group Bus operating at 1.5M words/s. Interface to Group Bus consists of microprocessor based DMA controller; component computers are Intel 8086 microcomputers

Thinking modems?

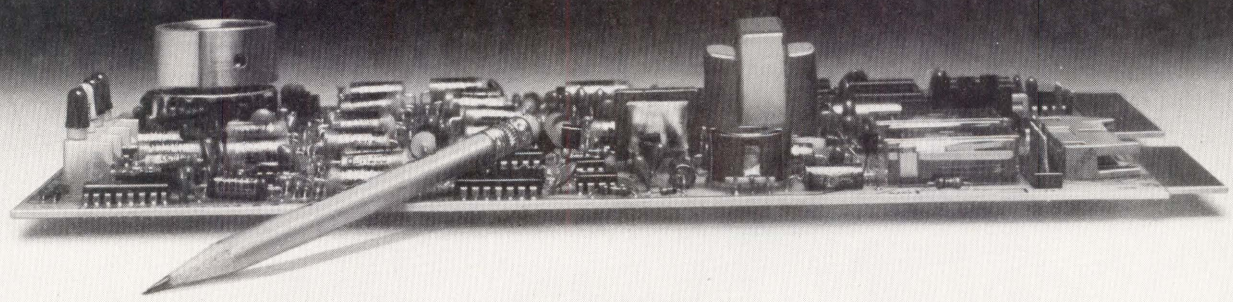
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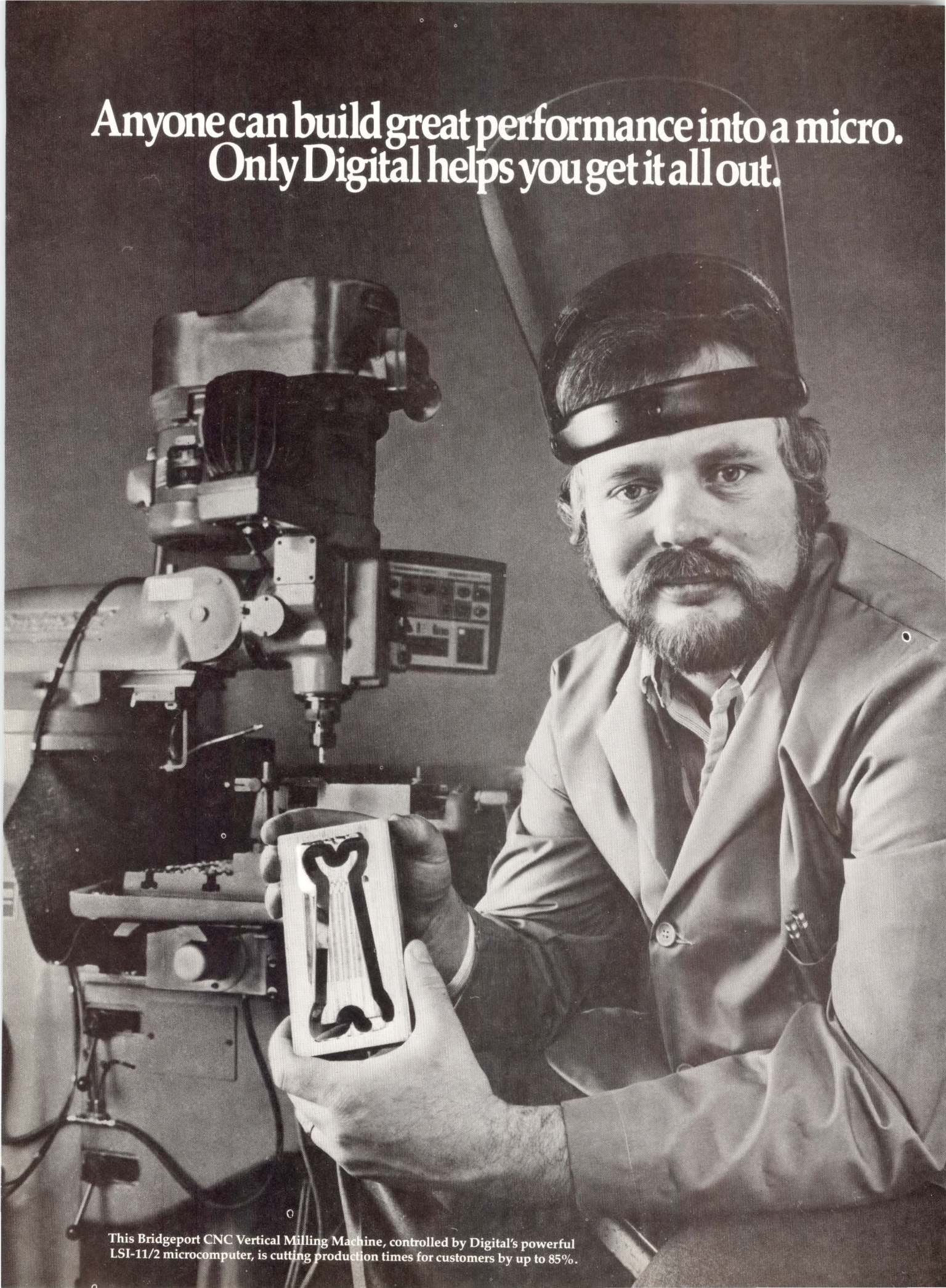


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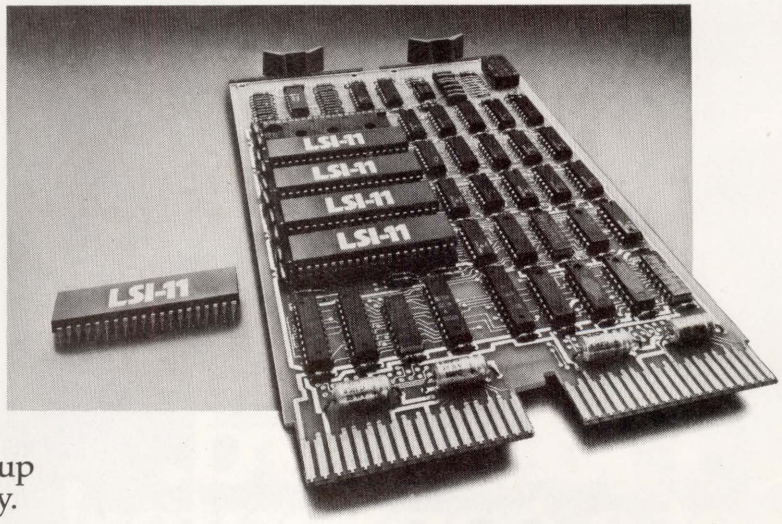
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CIRCLE 39 ON INQUIRY CARD

gram among processors in the system. This allows programs to be loaded onto expanded or reduced hardware configurations without change.

Despite its network-like multicomputer architecture, the system is a physically localized tightly coupled multiple processor. The block transfer communications system operates efficiently and offers flexibility in designing interconnection strategies. Since it performs no address mapping, nonhomogeneous multicomputer systems can be constructed.

Heart of the system, one copy of the DEMOS kernel resides on each computer in the system. Each kernel manages intercomputer communications and provides runtime support to local Concurrent Pascal program. Because it supports a number of features of Concurrent Pascal as well as intercomputer communications and device driving, its functions are well-defined. Although coded in a low level language, it could be implemented modularly.

In handling scheduling of execution of concurrent processes, the kernel uses a scheduling algorithm to dynamically allocate priorities to processes. Access to the monitor is controlled through the implementation of FIFO queues in which processes wait their turn to use the monitor. Device drivers also form part of the kernel. Since I/O devices are accessed through the monitor, complexity of the device drivers is reduced, making them simple to code.

Final function of the kernel is to deal with intercomputer message transmission. In the system program, components running on different machines communicate through calls to and returns from monitor entry procedures with data passed on procedure parameters. Tables in each kernel contain data on allocation of code in various machines and are used in setting up messages. Communication is carried out using the RQTS protocol which is implemented in a single module of the kernel.

The system's constituent computers are connected to the intercomputer communication system through the group bus interface, which is based on a microprocessor with a direct memory access LSI device. This bus under control of kernel software transfers data between a processor's store and the block transfer mechanism. It provides the computer with one input and one output channel. Each input channel is associated with an area in memory to which arriving data blocks are sent.

The block transfer mechanism, a multiported communications system, transmits arbitrary length blocks from port to port. In DEMOS 86 this mechanism is implemented as a traditional computer bus wide enough to transmit one 16-bit word clocked at 1.5 MHz. A bus arbiter controls access to the bus. Arbiter protocol scans ports in fixed order and allocates the group bus for a packet transfer when it finds one requiring service. At the end of the transfer it frees the bus and continues its scan.

Currently implemented using the Intel 8086 and written in Pascal, future systems will be based on multiple-processor configurations using the Ada language for systems and applications software and for a range of architectures. The DEMOS concept is intended for realtime applications that include process control and monitoring, automation, communication systems, interactive information systems, realtime simulation, and transaction processing. □

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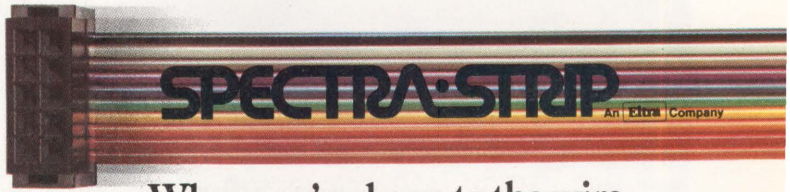
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Tell them you want to see how tough they are."

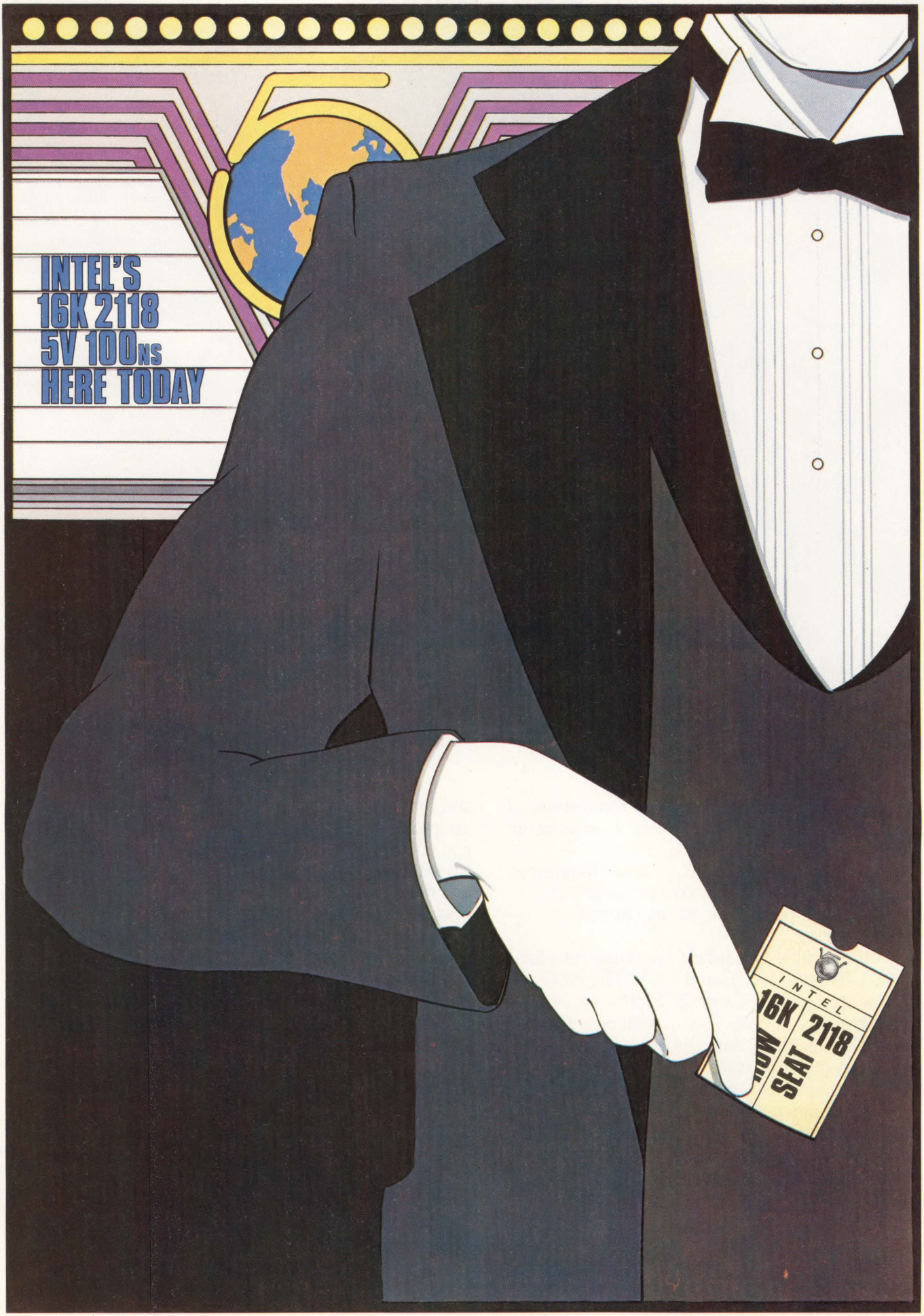
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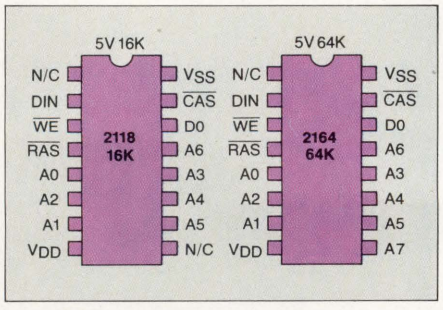
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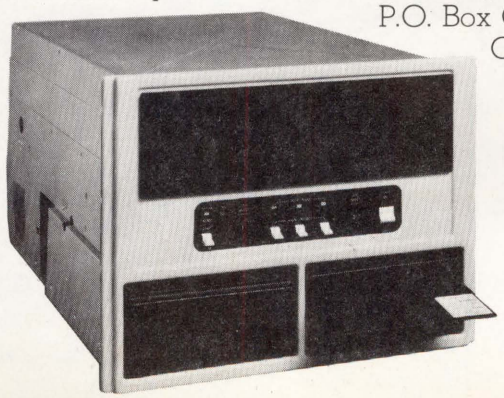
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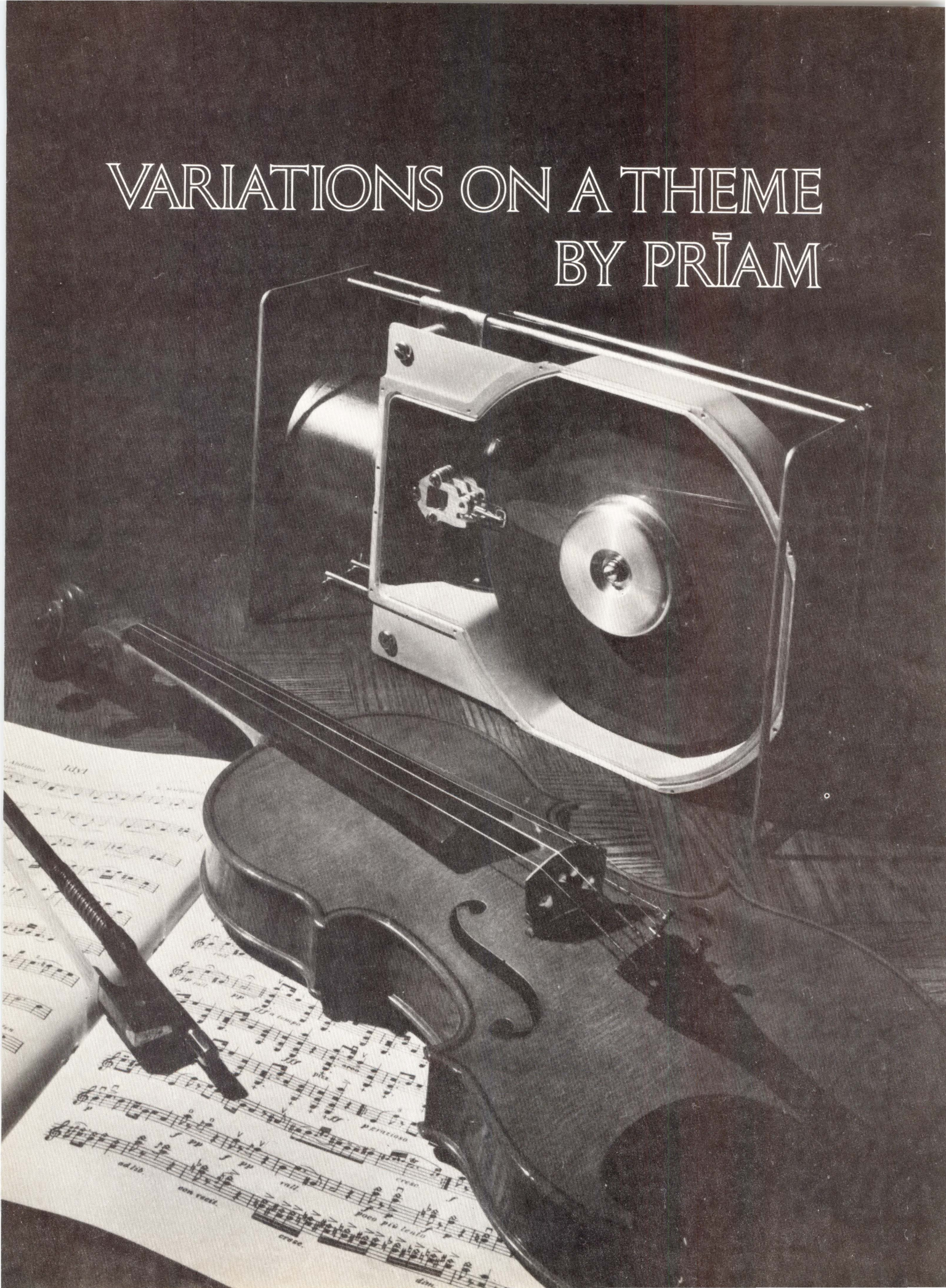
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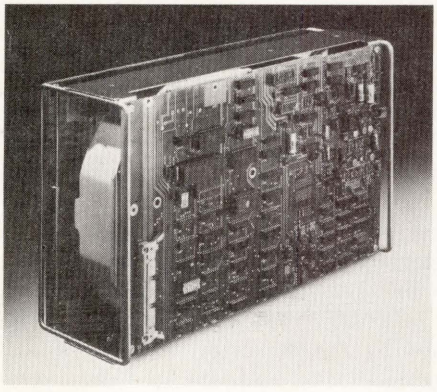


DISKŌS 2050 AND 3450 8" WINCHESTER DISC DRIVES

This Tune May Sound Familiar . . .

Variations are created from the elements of a composition, changed to create a new and interesting idea. PRIAM's DISKOS 2050 and 3450 are variations on a Winchester disc drive design theme that has been proved in concept, performance, and production.

PRIAM design engineers followed the same design composition that has made the 14-inch-disc DISKOS 3350 efficient, reliable and cost effective. They scaled the DISKOS 2050 and 3450 to fit exactly into the space required by a standard floppy disc drive. This noteworthy accomplishment provides capacities of 20 and 34 megabytes, with 40 and 68-megabyte capacities to follow, with the same size and weight.



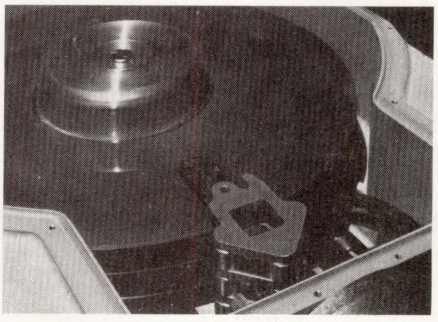
Interface Harmony

PRIAM's DISKOS 2050 and 3450 play from the same interface music as the DISKOS 3350, so that a single controller can be used with PRIAM Winchester disc drives covering the capacity scale from 20 to 154 megabytes. Head positioning times, data transfer rate, data and command functions and lines . . . every pin connection is the same. And *data separation is included* in all PRIAM drives, saving you expense in interfacing.

Sing Along With SMD

An optional interface permits you to use PRIAM drives with existing controllers for CDC Storage Module Drives. You can stretch the life of your SMD controller and get on the air more quickly with the low cost, high capacity, and splendid reliability of PRIAM Winchester disc drives.

See us at N.C.C., booth #347 & 349, Disneyland Hotel underground exhibit facility.



Presto Positioning

PRIAM's proprietary linear voice coil head positioner provides fast access to data and still lets the DISKOS 2050 and 3450 exactly replace a standard floppy disc drive. Positioning is fast and precise, with an average access time of 50 milliseconds, and a track-to-track time of only 10 milliseconds. Because of the exact positioning provided by PRIAM'S voice coil system, data recovery is positive and reliable. DISKOS drives will tolerate the harsher environments in which computers, word processors, and communications systems of the future will operate.

Brushless DC Spindle Motor

A brushless DC spindle motor provides reliable operation with a simple, low-cost design, doing away with belts and pulleys and extra bearings. PRIAM's DC spindle motor eliminates alternating current entirely from the DISKOS 2050 and 3450. They will operate anywhere in the world without change.

Microprocessor Maestro

Economy, flexibility and reliability result from PRIAM's use of a microprocessor to control head positioning and to perform self test and diagnostics. The number of parts and electrical connections in the system are reduced to lower cost and improve reliability.

Welded Steel Rod Frame

PRIAM's DISKOS 2050 and 3450 mainframe castings are mounted in sturdy welded steel rod frames that permit ready circulation of cooling air. These frames also reduce weight and cost. Heavy metal is used only where it is needed, so the DISKOS 2050 and 3450 weigh only 20 pounds. Shock mounts protect the drives and isolate them from system ground.

Air for Reliability

PRIAM disc drives use a unique air management system to prevent contamination. Valuable data is protected by creating positive air pressure at the spindle bearings, where contamination is most likely to enter. PRIAM drives include permanent absolute filters that constantly purge the air inside the sealed disc assembly.

Specifications

DISKOS 2050 Capacity (unformatted)	20 Megabytes
DISKOS 3450 Capacity (unformatted)	34 Megabytes
Transfer rate	1.03 Mbytes/Sec
Track-to-track positioning	10 milliseconds
Average positioning	50 milliseconds
Tracks per inch	480
Bits per inch	6646
Height	4.62 inches
Width	8.55 inches
Depth	14.25 inches
Weight	20 pounds

Interface Efficiency

Interfacing DISKOS 2050 and 3450 disc drives to your controller is economical and efficient because it is designed for connection to the most widely used 8-bit and 16-bit microprocessors. Daisy chaining is easy and functional, and overlapped seeks may be used. Data separation is included in drive electronics, so controller design is simplified and reduced in cost.

Smart Interface

PRIAM's SMART Interface Adapter provides serialization and deserialization of data, disc formatting, sector buffer,polled or interrupt operation, defect mapping, overlapped commands, implied seek, selectable sector sizes and microdiagnostics. Up to four drives can be interfaced easily to the I/O bus at the byte level.

For a brief and handy history of Winchester technology and its advantages, call or write to PRIAM and ask for a copy of WHO'S SELLING RIFLES TO THE INDIANS? A Winchester Disc Drive Technology Primer. It's FREE!





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CIRCLE 43 ON INQUIRY CARD

Controllers Come of Age

Stan Groves

Motorola Integrated Circuits Division
Austin, Texas

Probably the most important advance in computer technology of the past several years has been the development of the large scale integrated circuit and the increasing ability to compact more and more components onto single silicon chips. This, in turn, has made possible the design and production of single-chip microprocessors and even microcomputers, which opened up a wide range of applications previously not even considered.

Although much of the glamour seems to exist in possible increases to large scale integration (LSI) capabilities that might some day provide the promised "single chip with the power of an IBM 370," the predominant application for microprocessors is in control rather than raw computing, number crunching assignments. Microprocessors are being used as central control elements in tape drives, printers, and other peripherals for processors or computers; as communication controllers; as building environment controllers; and as automobile engine and transmission controllers.

The difference in a controller function (even when done by a microprocessor) and a processing function is that the controller strives as best it can to perform a task assigned to it by an outside inte'ligence, such as a processor, which itself may be part of a larger controller. A processor executes *instructions,* making attendant decisions; a controller executes *commands,* with decisions reduced to "Is it time yet?" or an equivalent trivial—yet vital—capability.

Current Technology

Whether in a chemical processing plant, a home or building environment, or an automobile engine, a process controller will require some or all of the items in Fig 1. A typical controller may require analog inputs to be digitized before they may be used. It may require the determination of the frequency of a stream of pulses in order to then determine the status of a position to frequency transducer. It may also require determination of the period between successive pulses to relate vehicle speed, engine revolutions per minute, and other such data. When inputs occur, or take place within some range specified by the processor, some action is taken—sometimes merely signaling (or interrupting) the processor that the event has occurred. The controller may output a pulse or stream of pulses at a frequency determined by the processor, and the width of the pulses may be modulated with another parameter.

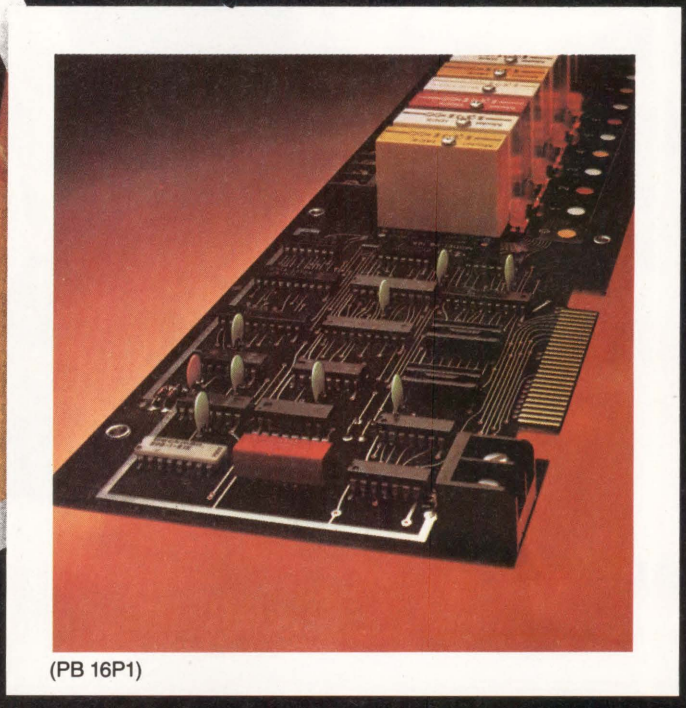
Nearly all of the items shown in Fig 1 can be placed on integrated circuit (IC) chips. The box labeled "signal conditioning," however, is the remnant of that task; because of present limitations of n-channel metal oxide semiconductor (NMOS), it cannot as yet be placed on ICs and is left to the circuit designer. (If steel mills, automobiles, and humans all ran on 5 V, most of this remainder would be eliminated.)

Although interrelated, the functions of processor and controller differ greatly. Suitability of a microprocessor to perform a given control function, either separate from or in addition to the computational function, is dependent on factors such as the number of inputs and outputs involved, the time allowable to respond to inputs, the resolution required at the outputs, and the complexity of the algorithm. When there are many inputs and outputs, and the computation required is a long, complex algorithm involving various pressures, temperatures, and positions, a separate controller can provide information, and maintain or change outputs according to the previous execution of the algorithm

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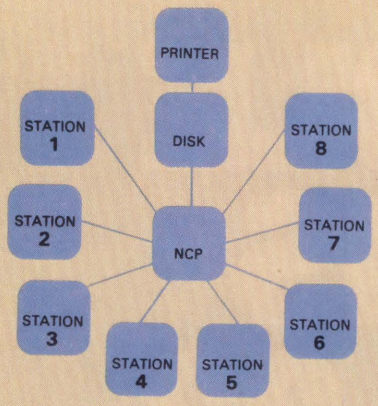
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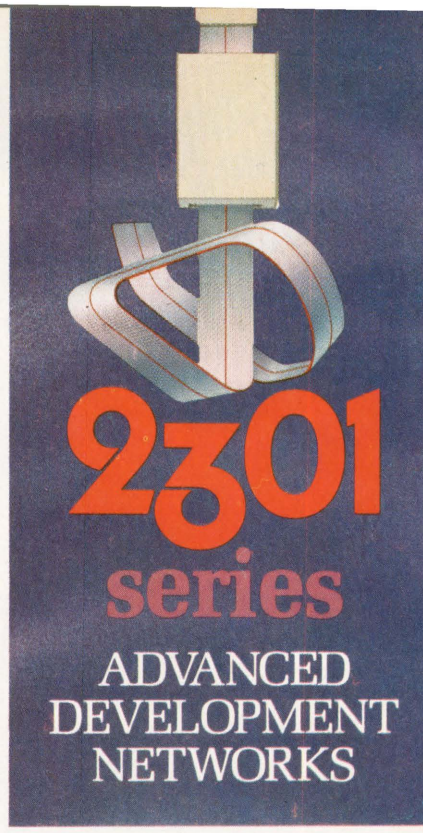
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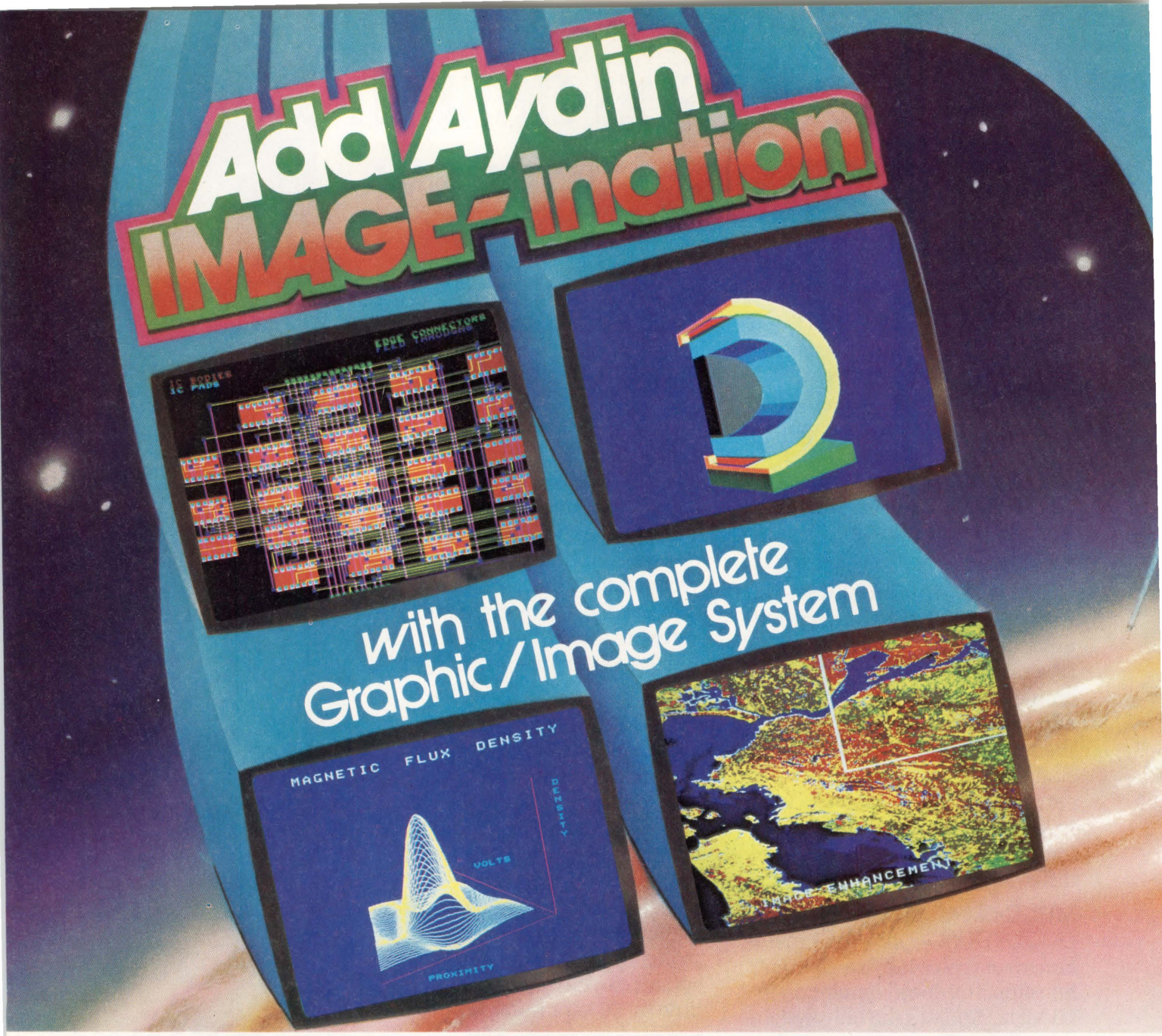
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by the processor. Even when the computational function is separated from the control functions, a high performance controller may require a more specialized architecture than is available in any off the shelf microprocessor.

Fig 2 is an expanded block diagram of the content of the "digital control" block from Fig 1. This is a deliberately nonelegant solution to an actual system requirement that will be described later. Note the inclusion of a dedicated processor to handle the control function, and the use of standard LSI functions. When multiple inputs and outputs are required, as indicated, several solutions are available; the suitability of each is dependent upon the number of inputs and the response time thereof, and the number of outputs and the extent of accuracy required. (If a single computing element is to handle the control function *and* the processing function, complexity of the processing algorithm is also a consideration.) Control parameters such as pulse rates and widths desired must be passed from the processor functions to the control function in some manner, such as a dual-port random access memory (RAM) or direct memory access (DMA) arrangement.

Any of several possible approaches can be initiated to satisfy the requirements of this system. For example,

(1) If the resolution required is coarse enough, a single processor could scan or poll all the inputs and outputs in some required priority sequence.

(2) If technology permits, the raw speed of the processor and its control store could be increased until the resolution requirement is satisfied.

(3) If still greater effective simultaneity is required, separate timing functions could be implemented as shown in Fig 2, where each timer in effect becomes a subcontroller, able to maintain a given pulse train or to time a given pulse interval until directed otherwise.

In the first two approaches, a symmetrical, easy to understand instruction set can sometimes get in the way, since it may require execution at a multimegahertz rate in order to provide service within the allotted time. The third has the obvious disadvantage of requiring many large ICs, and will also require a fair amount of control store, estimated at around 2k bytes just for the control function shown.

The best solution, however, is always "think smarter, not harder." Use of a special purpose instruction set with an execution sequence determined by a specialized priority matrix of inputs, time intervals, and control elements will allow faster execution and therefore better resolution.

Fig 3 is a block diagram of a single 40-pin IC that can accomplish the total control function shown in Fig 2, and do a better job of it. This process may be envisioned as the amalgamation and redistribution of the previous attributes, with attendant improvement in such things as performance, power, packaging, and price. The control read only memory (ROM) is now only 128 bytes (64 x 16); the "processor" controlled thereby is a 16-bit arithmetic logic unit (ALU) with fewer than 16 commands. Operational parameters

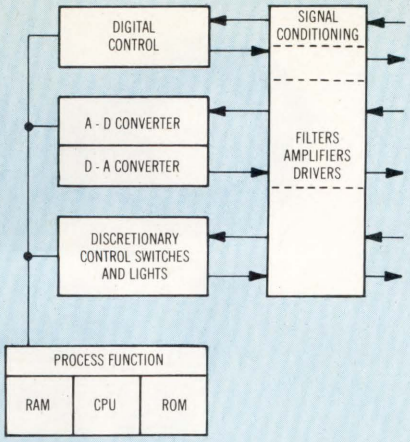


Fig 1 Typical process control system. Control program stored in ROM is executed by CPU to sample switch closures, variable voltage levels, or digital information from other systems or central panels. Information is stored in RAM and manipulated by appropriate algorithms. It is then output to switch controllers to turn on lights or solenoid drivers, or to D-A converters and buffers to drive such things as linear positioners or variable oven heaters and, when appropriate, to output status information back to central system through adaptive signal conditioning interface circuits



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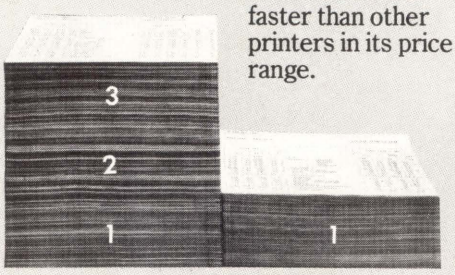
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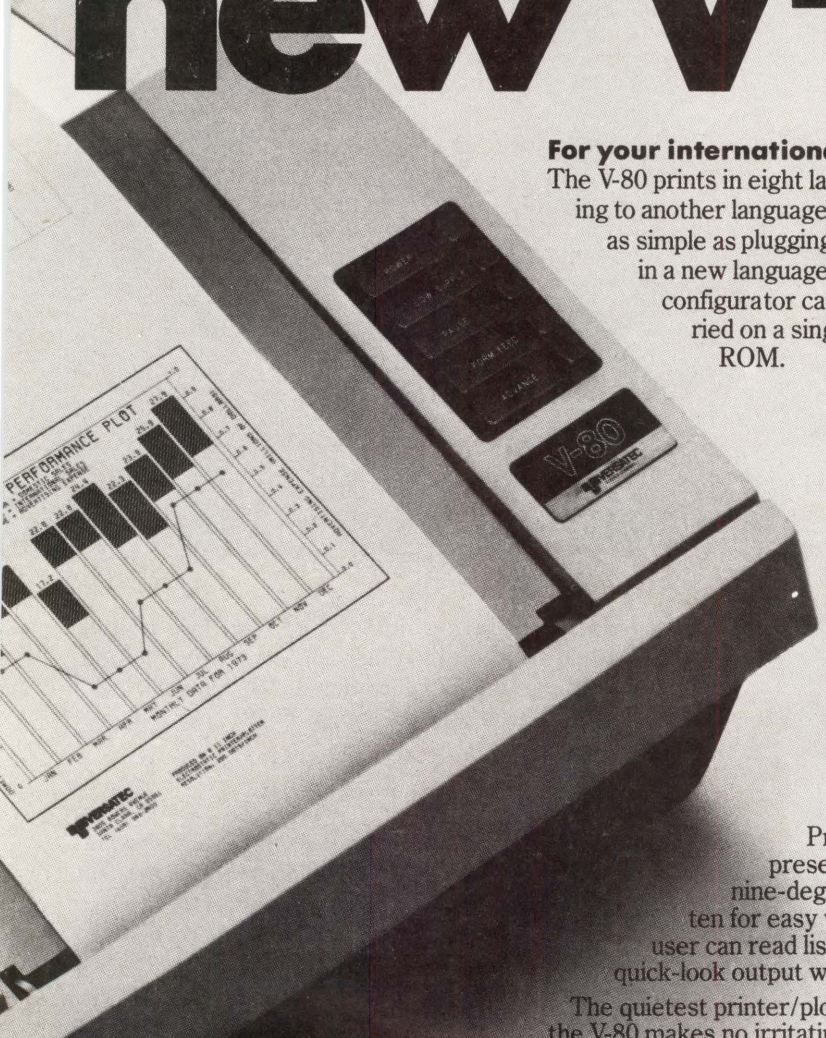
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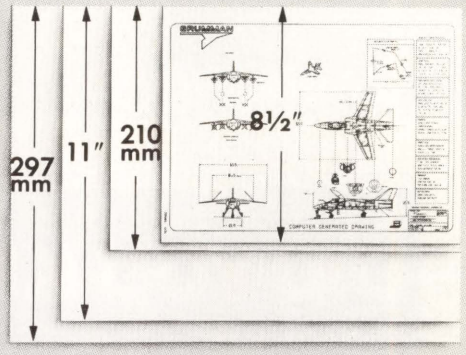


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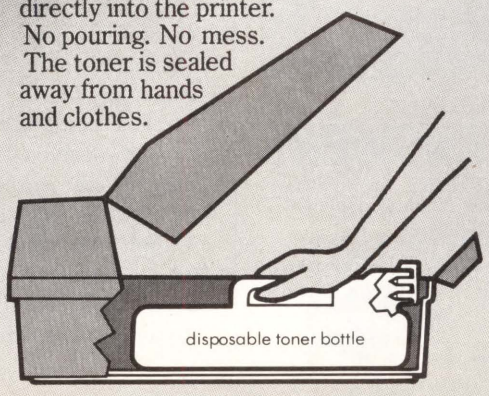
Paper widths of standard 8½ and 11-inch *and* international A4 (210 millimeter "Portrait" and 297 millimeter "Landscape").



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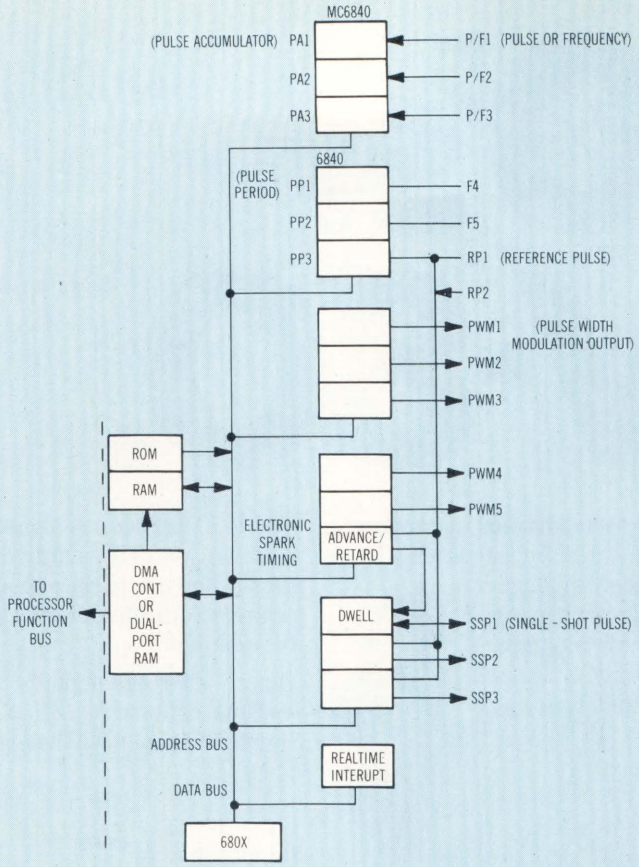


Fig 2 Expanded digital control function. After receiving control information determined by algorithm in processor, control function executes function. Width modulated pulse trains can drive flutter valves in vacuum motor to control throttle position. Two timers combine to control dwell, advance, or retard for electronic spark timing. SSP2 and 3 can drive electronic fuel injection valves. Pulse intervals or frequencies are measured by controller to determine velocity, engine revolution speed, or position feedback. Realtime interrupt provides processor with basic time reference



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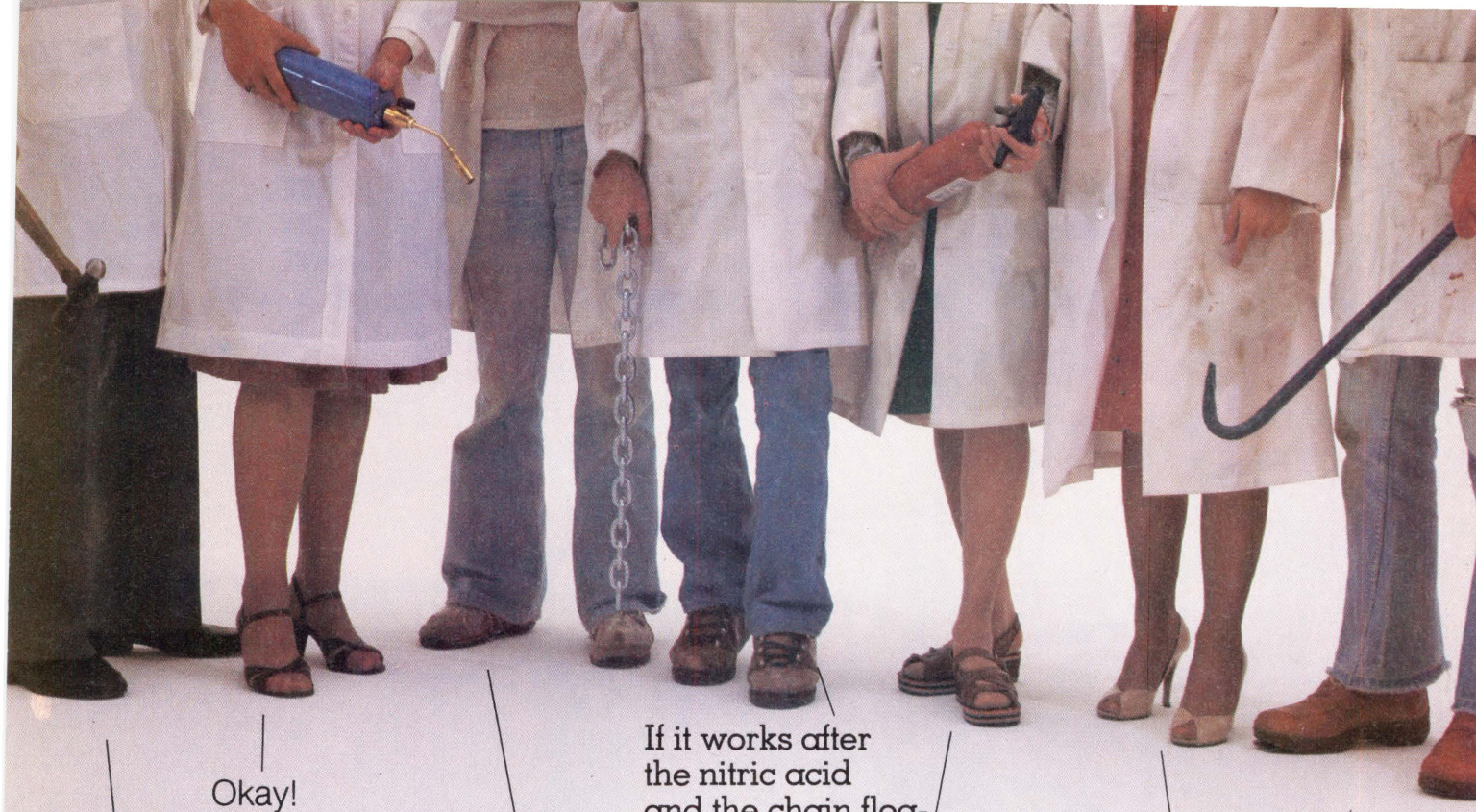
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(pulse frequency, pulse width desired, etc) are placed into the 28 x 16 RAM by the processor executing the major algorithm, over an uncluttered "peripheral chip" interface. The 9 to 12 large ICs of Fig 2 are reduced to one 40-pin device.

Automobile Engine Control

Electronic control of an automobile internal combustion engine has appeared disarmingly simple, and has proven to be frustratingly complex. Manufacturers were driven to the use of computerized engine control by a combination of regulations requiring the reduction of environmental pollution and improvement of the corporate average fuel economy (CAFE). These requirements conflict intensely in the optimum configuration of the engine. (Remember the 1974 models with very low pollution, but the worst ever CAFE? No regulation was yet in force to require fuel economy.)

Adequate engine control requires measurement of parameters such as intake manifold absolute pressure (vacuum), stoichiometric operation (via oxygen in the exhaust), engine demand (throttle position, etc), engine and atmospheric temperature, engine knock, and others. Once a computer system is in the car, other benefits may be derived from it, such as displaying and measuring velocity (miles per hour), time of day, and engine revolutions per minute, as indicated in Fig 4. Control output may include a pulse width modulated (PWM) stream to electrically modulate a vacuum motor to serve as a cruise control. Outputs will likely include a PWM stream for controlling air/fuel mix (AFM) for carbureted



Nobody leaves until we prove something here. I want heat, I want cold, I want wet, I want... *violence!*

Okay! Can I help it if nothing happens when I burn it with the blowtorch?

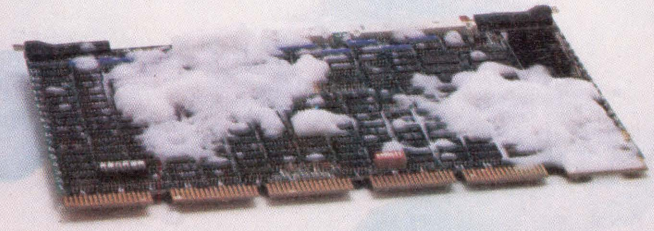
I don't think this will work. No matter how tough our tests are, you can't prove reliability in an ad.

If it works after the nitric acid and the chain flogging, what more could they want?

Come on. The pressure's gone down in the fire extinguisher.

They'll probably want us to *prove* it still works. Now, how are we going to do that?

Why don't they just call or send the coupon and we'll show them in person? I can't take this any more.



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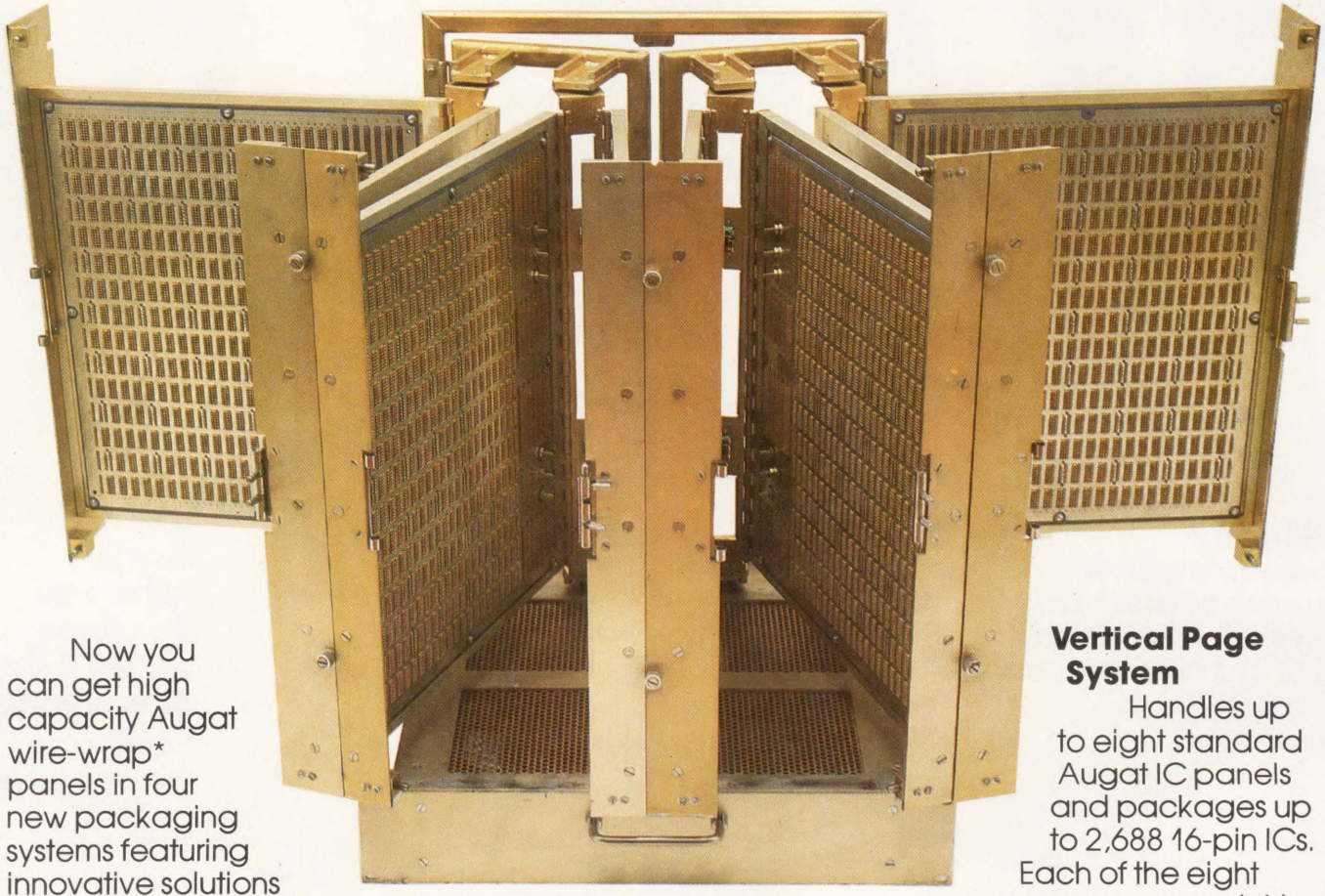
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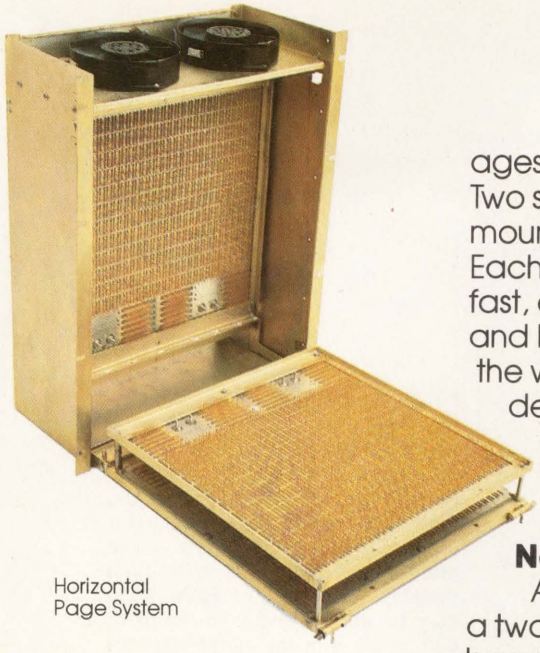
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Horizontal Card Cage

This flexible system lets you combine analog and digital; wire-wrap and



Horizontal
Page System

stitch-wire; and single, double and triple width boards in the same enclosure. Choose either a continuous backplane or three separate backplanes to provide the different voltages and grounds needed to mix analog and digital boards. All are assembled with 96-pin I/O connectors. Flexible spacing lets you use up to four wire-wrap* boards (1.2" spacing) or 7 stitch-wire boards (.6" spacing) or a combination of the two. Guide separators let you mix different width boards. Fans are optional.

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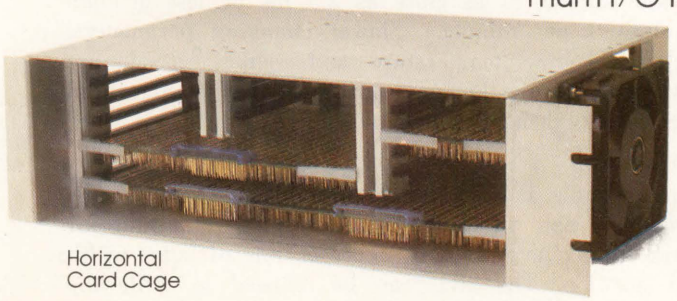
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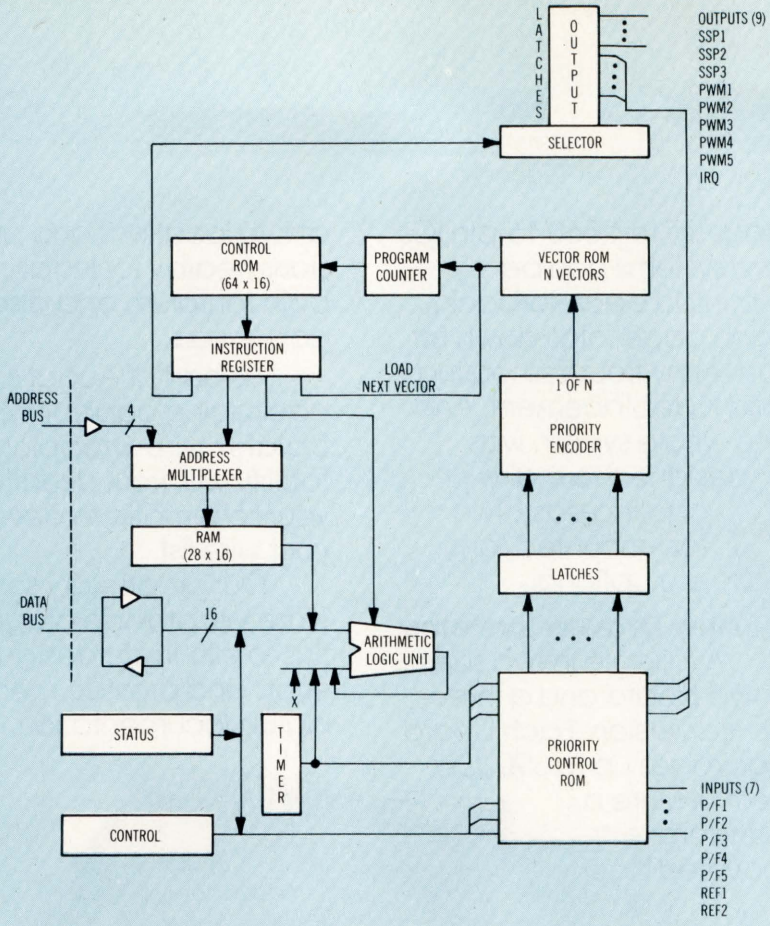


Fig 3 Monolithic digital controller. Inputs from transducers such as distributor reference pulse are prioritized by mask programmable ROM. Input events and periodic timer frequencies cause vector (address) to select one or more control words to fill instruction register. Contents of RAM cells may be incremented, added to or compared with the timer, and returned. When predetermined limits (input through data bus from processor) occur, output may be turned on or off, or interrupt sent to processor

engines [or injector pulses for electronic fuel injection (EFI) engines], and single pulses with discrete direction indication for idle speed control and electronic choke control.

Electronic spark timing (EST) requires the input of a reference pulse, which originates in a coil swept by a magnetic "transfluxer" or rotor in the ignition distributor. (Shaping the analog output, which can vary from a few millivolts at idle to 50 V at high revolutions per minute, is another nightmare!) The EST output pulse must be controlled in length to ensure that sufficient energy will be available to allow the high energy ignition to fire a sparkplug when the pulse ends. End of the EST pulse must be precisely placed relative to the reference pulse, because "here's where it all comes together." Timing affects pollution, economy, performance, and engine life.

The algorithm-processing computer (call it the MPU) measures engine revolutions per minute (using the reference pulse), temperatures, pressures, and such mentioned earlier; in addition, it computes new parameters for air/fuel mix or injector pulse length, spark advance or retard position, and any requisite adjustments to idle speed or cruise control. These new control parameters are then passed to the engine controller, which will maintain the new settings while the processor executes another pass through the algorithm.

An ideal system would permit the entire algorithm to be executed at least once before each ignition pulse occurs, and some day that may be possible. Currently, only the more critical measurements are made, with control changes output every 8 to 10 ms. (Reference pulses and EST outputs may be 25 ms or more apart at idle speeds, to as close as 2.5 ms or less at high revolutions per minute.) Slower changing parameters, such as engine temperature and vehicle speed, are sampled periodically and portions of the algorithm affected may then be executed less often.

The Control

Suppose now that the MPU has just passed, to the controller, new values for air/fuel mix PWM and for spark timing, expressed in microseconds of pulse width and position. The MPU can be allowed to write the new value desired for air/fuel mix pulse width or fre-

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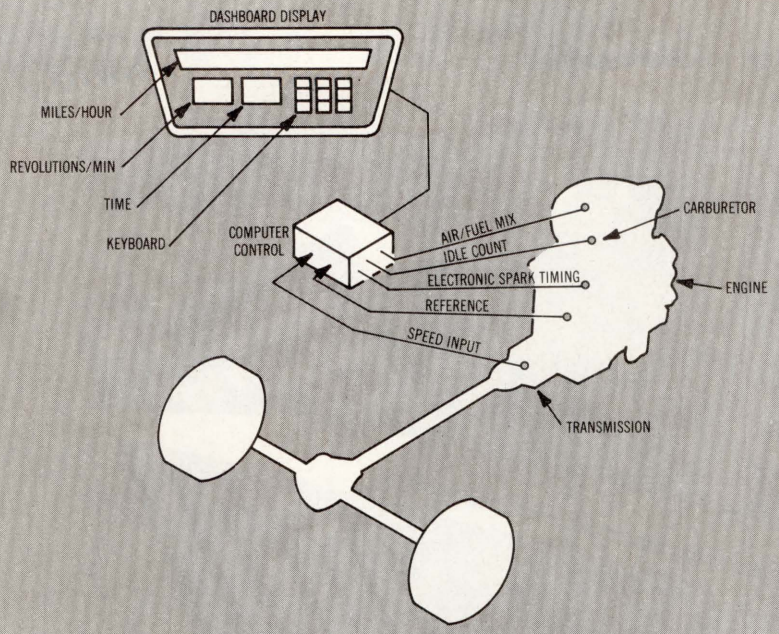


Fig 4 Automobile engine control and display. Vehicle speed, distributor reference, manifold pressure, and related factors enable engine control module to control idle speed, air/fuel mix, or electronic spark timing. Digital display of velocity, engine revolution speed, time of day, and fuel economy are incidental benefits now available from engine control module

quency directly into the RAM cell used by the controller (as described later) to determine the PWM output. When a change occurs, the worst that might happen is the output of an intermediate width pulse between the old and the new values.

Not so with spark timing. This, and some other parameters as well, must be double-buffered. The MPU could only with great difficulty, if at all, determine just where in a given cycle the current action is taking place. That is the function of the controller.

Each time the controller determines that it is now time to turn on the EST output, the controller must compute when the pulse should be turned off, in order to fire the fuel mix. The numbers so carefully determined and passed by the MPU (to the closest microsecond) refer to advance or retard of the spark with respect to the *next* reference pulse. The controller knows only when the *last* reference occurred, and so must keep a running reference period in order to *predict* the next reference. This period is also a convenient means of determining engine revolution speed.

Notice that we are now using reference pulses 90° and 180° in the past to compute a firing time. Even running steady state, the reference pulse period may change due to mechanical accuracy, backlash, and other mechanical eccentricities. However, suppose your car is idling in the driveway and your child suddenly "floorboards" the accelerator. Those 6- or 8-ms pulses nicely placed 3 or 4 ms prior to the next reference pulse will not remain correct very long when the engine revolution speed is changing up to 3000 r/min/s. That is a change of about 5/25-ms firing interval, when starting at idle engine revolution speed.

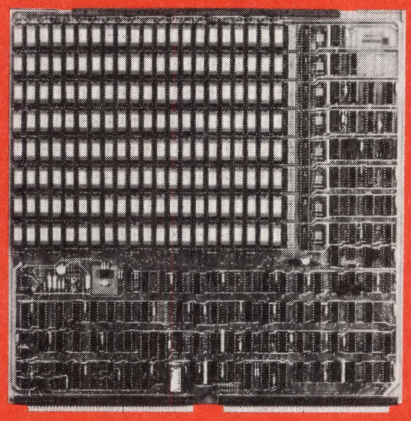
Even though values computed by the MPU are long since out of date for optimum performance, the controller still must try to maintain the last valid timing to avoid not firing at all. Failure to ignite even a single cylinder of fuel mixture can adversely affect the engine pollution tests. Therefore, with each reference pulse, the controller will recompute the proper position of the next (rising or falling) edge of EST output. Similarly, when new values for firing time or pulse width (dwell) are passed by the MPU, the controller will adjust the next edge by the amount of the change, and place the new values where they will be used for the next computation.

The Controller

Returning to the controller block diagram in Fig 3, notice the significant features.

- A 64 x 16 control ROM contains the microcode commands executed in the instruction register (IR) at a nominal 1-MHz rate.
- A 28 x 16 RAM contains initial control parameters and intermediate results. The RAM is addressable for reading and writing by both the controller IR and the MPU.
- A set of 15 flags has individual bits which may be set or cleared by the instruction word, either conditionally or unconditionally. Some of these flags go to output drives, some to a programmable logic array (PLA), and some to both.
- A 16-bit control register allows MPU control over various microcode sequences, direct control over an output pin, and enable or disable of interrupt requests to the MPU.

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- A 20-bit binary counter/timer is freerunning at the controller clock rate. The upper 16 bits are available to the ALU for addition, or comparison.
- A 6-bit program counter allows sequencing through a microcode string. The counter is initialized to the beginning of each string by the output of a vector ROM.
- The vector ROM contains n different 6-bit vectors; the applicable vector is selected by the output of a priority encoder.
- A 1-of-n priority encoder selects only the highest priority from the n different inputs from a priority control ROM.
- A priority control ROM, a matrix of outputs of the control register, the timer, the various inputs, and some of the output flags controlled by the instruction register are the conjunction (AND gate) half of a PLA.

Consider one of the more simple tasks of the controller—output of a controlled length EFI pulse. The MPU provides to the controller a number representing length of the pulse. Occurrence of a distributor reference pulse, input to the controller, sets a latch at the output of the priority control ROM. (The control ROM allows a bit from the control register to be ANDed with the reference pulse to turn EFI on and off.) The latch output, when conditioned by the priority encoder, selects a vector from the vector ROM.

One bit of the instruction word, designated "load next vector," indicates the occurrence of the last instruction in a string. When true, this bit will permit setting the sequence counter to the value of the vector. This particular instruction sequence will access the RAM location containing the pulse length, add to it the present value of the counter/timer, and store the result in another RAM location as a working counter. It will also turn on an output to the EFI drives.

Various bits of the timer are input to the control ROM. Selection of one of these, say 64 kHz, is made according to the resolution required of the pulse. Each 16 μs (64 kHz) another latch will be set, selecting another vector, which will access an instruction to be placed in the instruction register. This instruction will access the working counter in RAM and compare it to the freerunning timer. When the timer finally passes the value in the RAM location, the output to the EFI drives will be turned off.

This approach allows pulse lengths up to approximately 0.5 s. An alternative approach permits longer pulses or time intervals, with reduced resolution. In this case, the working counter (in RAM) contains a number representing the quantity of time intervals of the desired granularity, such as 1/16 or 1 kHz, selected in the control ROM. The instruction sequence accesses the working RAM cell, decrements the value therein, and replaces it. When the value is decremented to 0, the desired action takes place.

Still another action that may be carried out is typified by the speedometer—that of pulse period measurement. Here, the occurrence of a pulse causes the controller to access a RAM cell containing the value of the timer at the last occurrence of the pulse, subtracting



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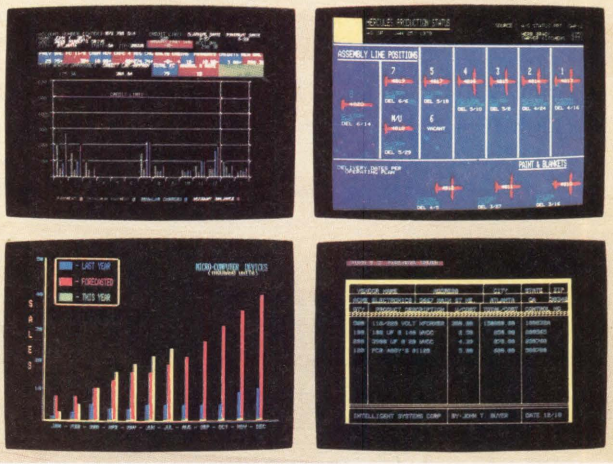
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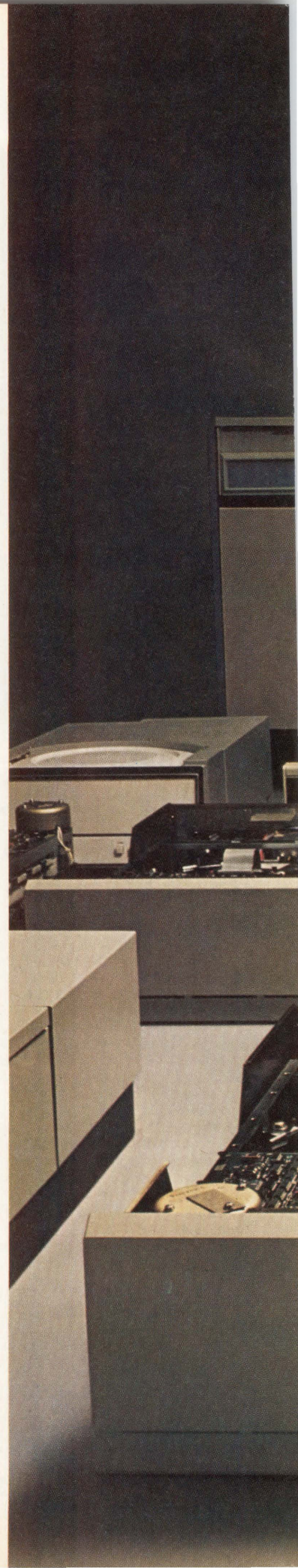
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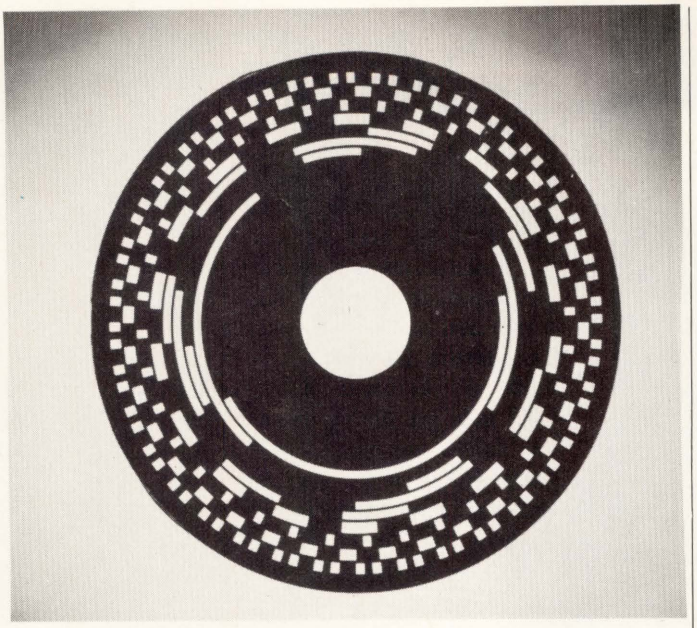
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it from the present timer value, then saving the difference and the present timer value in RAM locations. This is the method used to get the reference period as mentioned earlier for spark timing.

Other RAM cells may be used for simple pulse accumulation when incremented at each occurrence of some input. By reading the RAM location at fixed time intervals, the MPU can determine pulse rate inputs from position to frequency transducers or similar sensors.

The controller has one unusual feature that enhances operation and minimizes control ROM requirements. First, the instruction register and command operations must be arranged such that no-transistor(s) in the control ROM is interpreted as no-operation for that bit or field, except for the load next vector bit, which is enabled. Control ROM word 63 is reserved as the default location, with such a NO-OP contained therein. In the absence of any external stimulus, the load next vector logic continually loads a vector to the default location. Occurrence of a stimulus from the timer or some input can then immediately cause the appropriate vector to be loaded. Individual sequences of 1, 2, or 10 control words can be executed in a sequence determined by the priority ROM and encoder. Execution of single-word operations with no attendant testing and jumping also minimizes the time required to do a given task.

The Application

This particular controller has been programmed to serve as an engine controller, with control inputs from an enhanced M6800 type MPU. The controller can cover several capabilities.

- Three pulse accumulator/counters of 16-bit capacity, with a 40-kHz maximum counting rate, for position to frequency transducers.
- Three pulse period measurements, from the reference pulse, to the closest 1/32-kHz interval, and two others (for speedometer etc) to the closest 1/16 kHz of true interval. These latter two must be able to output a maskable interrupt request to the MPU.
- Five PWM outputs with a rate programmable from 7.8 to 125 Hz, and a width programmable from 0 to 100% to within 1/32-kHz interval. Two of these outputs may also be controlled to produce single pulses, used for such things as idle speed control, electric choke control, exhaust gas recirculation control, air/fuel mix, and cruise control.
- The EST output, whose output length and location in relation to the reference pulse are both controlled to 1/32 kHz. Control and update of EST take over half of the control words available.
- Two EFI pulse outputs, each of which turns on when the associated reference pulse occurs, and the length is controlled to within 1/64 kHz.
- A maskable realtime interrupt, with interrupt rate input from the MPU accurate to 1/16 kHz. This line is typically tied to the IRQ input of the MPU.
- Two discrete outputs taken directly from the control register. These are used in a control mode feedback. An external monitor device requires that the MPU

You can count on experience. Beehive has been a forerunner in the terminal marketplace since 1968 when we were known as Beehive Electrotech and had only one terminal product.

Beehive has pioneered terminal graphics, the use of microprocessors and was the first to develop the concept of CRT modularity. We have remained firmly entrenched within diverse, growing and rapidly changing markets by utilizing a planned and calculated approach to the design and development of a reliable terminal product array that now ranges from dumb to very smart, from standard to custom. At the same time, we have not lost sight of our most important asset, you the customer. Quality is just part of the package.

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Our success and growth has been the result of providing a full line of conversational and editing terminals from which to choose, in addition to being responsive to needs unique to individual customers.

In the ten years since inception we have changed our name to Beehive International to more accurately reflect our growth, our success and our scope of operations. Beehive's increasing international presence is directly supported with a subsidiary located in Amsterdam, The Netherlands, and a comprehensive distributor network covering 35 countries. Beehive products are currently solving a large variety of data processing problems around the world as we continue to focus on what has made us successful...

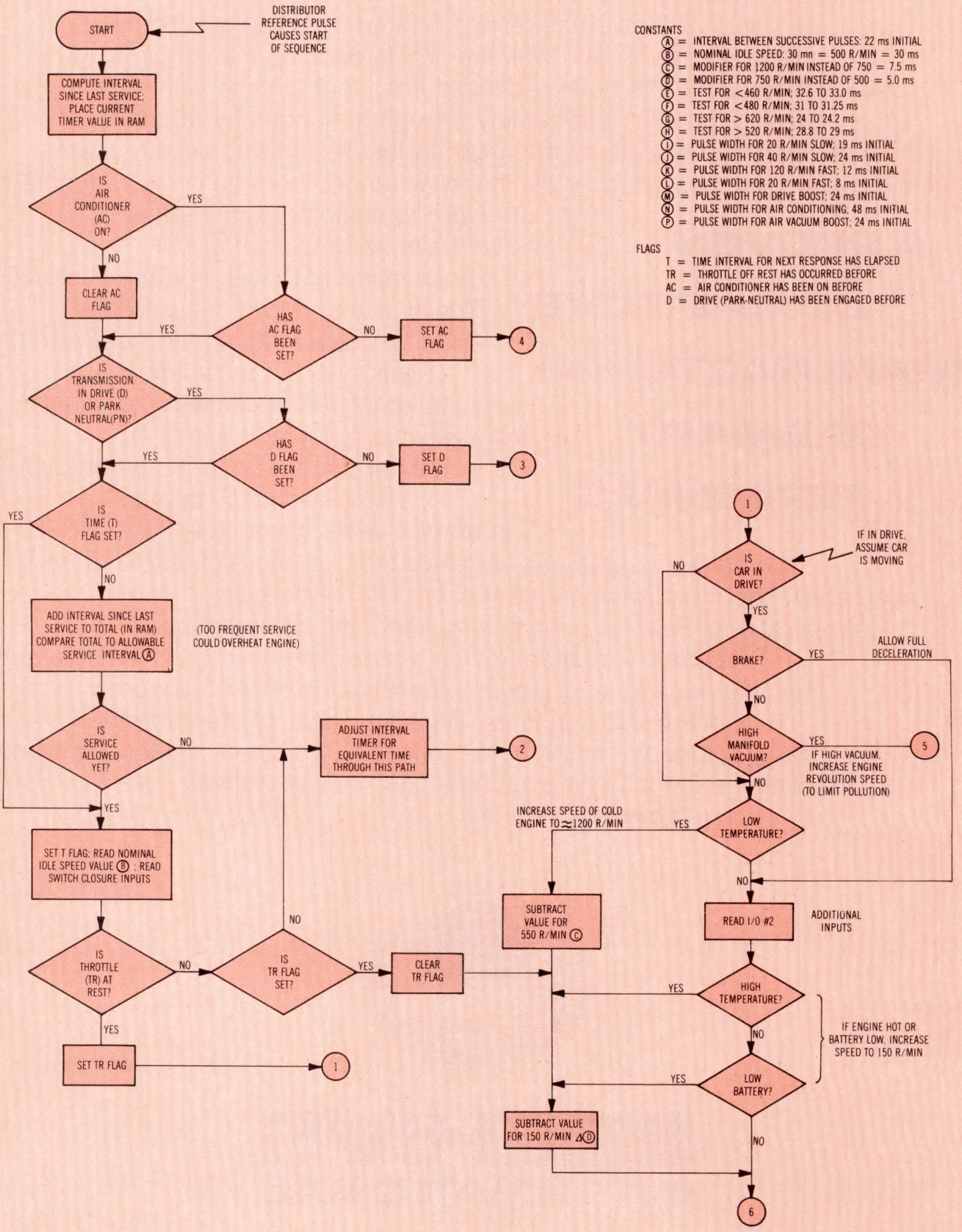
you the customer.



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CIRCLE 58 ON INQUIRY CARD


START
DISTRIBUTOR REFERENCE PULSE CAUSES START OF SEQUENCE
COMPUTE INTERVAL SINCE LAST SERVICE; PLACE CURRENT TIMER VALUE IN RAM
IS AIR CONDITIONER (AC) ON?
YES
NO
CLEAR AC FLAG
HAS AC FLAG BEEN SET?
NO
SET AC FLAG
4
YES
IS TRANSMISSION IN DRIVE (D) OR PARK NEUTRAL(PN)?
YES
HAS D FLAG BEEN SET?
NO
SET D FLAG
3
YES
IS TIME (T) FLAG SET?
YES
NO
ADD INTERVAL SINCE LAST SERVICE TO TOTAL (IN RAM) COMPARE TOTAL TO ALLOWABLE SERVICE INTERVAL Ⓐ
(TOO FREQUENT SERVICE COULD OVERHEAT ENGINE)
IS SERVICE ALLOWED YET?
NO
ADJUST INTERVAL TIMER FOR EQUIVALENT TIME THROUGH THIS PATH
2
YES
SET T FLAG; READ NOMINAL IDLE SPEED VALUE Ⓑ ; READ SWITCH CLOSURE INPUTS
IS THROTTLE (TR) AT REST?
NO
IS TR FLAG SET?
YES
CLEAR TR FLAG
NO
YES
SET TR FLAG
1
CONSTANTS
Ⓐ = INTERVAL BETWEEN SUCCESSIVE PULSES: 22 ms INITIAL
Ⓑ = NOMINAL IDLE SPEED: 30 mn = 500 R/MIN = 30 ms
Ⓒ = MODIFIER FOR 1200 R/MIN INSTEAD OF 750 = 7.5 ms
Ⓓ = MODIFIER FOR 750 R/MIN INSTEAD OF 500 = 5.0 ms
Ⓔ = TEST FOR <460 R/MIN; 32.6 TO 33.0 ms
Ⓕ = TEST FOR <480 R/MIN; 31 TO 31.25 ms
Ⓖ = TEST FOR > 620 R/MIN; 24 TO 24.2 ms
Ⓗ = TEST FOR > 520 R/MIN; 28.8 TO 29 ms
Ⓘ = PULSE WIDTH FOR 20 R/MIN SLOW; 19 ms INITIAL
Ⓙ = PULSE WIDTH FOR 40 R/MIN SLOW; 24 ms INITIAL
Ⓚ = PULSE WIDTH FOR 120 R/MIN FAST; 12 ms INITIAL
Ⓛ = PULSE WIDTH FOR 20 R/MIN FAST; 8 ms INITIAL
Ⓜ = PULSE WIDTH FOR DRIVE BOOST; 24 ms INITIAL
Ⓝ = PULSE WIDTH FOR AIR CONDITIONING; 48 ms INITIAL
Ⓟ = PULSE WIDTH FOR AIR VACUUM BOOST; 24 ms INITIAL
FLAGS
T = TIME INTERVAL FOR NEXT RESPONSE HAS ELAPSED
TR = THROTTLE OFF REST HAS OCCURRED BEFORE
AC = AIR CONDITIONER HAS BEEN ON BEFORE
D = DRIVE (PARK-NEUTRAL) HAS BEEN ENGAGED BEFORE
1
IF IN DRIVE, ASSUME CAR IS MOVING
IS CAR IN DRIVE?
NO
YES
BRAKE?
YES
ALLOW FULL DECELERATION
NO
HIGH MANIFOLD VACUUM?
YES
5
IF HIGH VACUUM, INCREASE ENGINE REVOLUTION SPEED (TO LIMIT POLLUTION)
NO
INCREASE SPEED OF COLD ENGINE TO ≈1200 R/MIN
YES
LOW TEMPERATURE?
NO
SUBTRACT VALUE FOR 550 R/MIN Ⓒ
READ I/O #2
ADDITIONAL INPUTS
YES
HIGH TEMPERATURE?
NO
IF ENGINE HOT OR BATTERY LOW, INCREASE SPEED TO 150 R/MIN
YES
LOW BATTERY?
NO
SUBTRACT VALUE FOR 150 R/MIN ΔⒹ
6

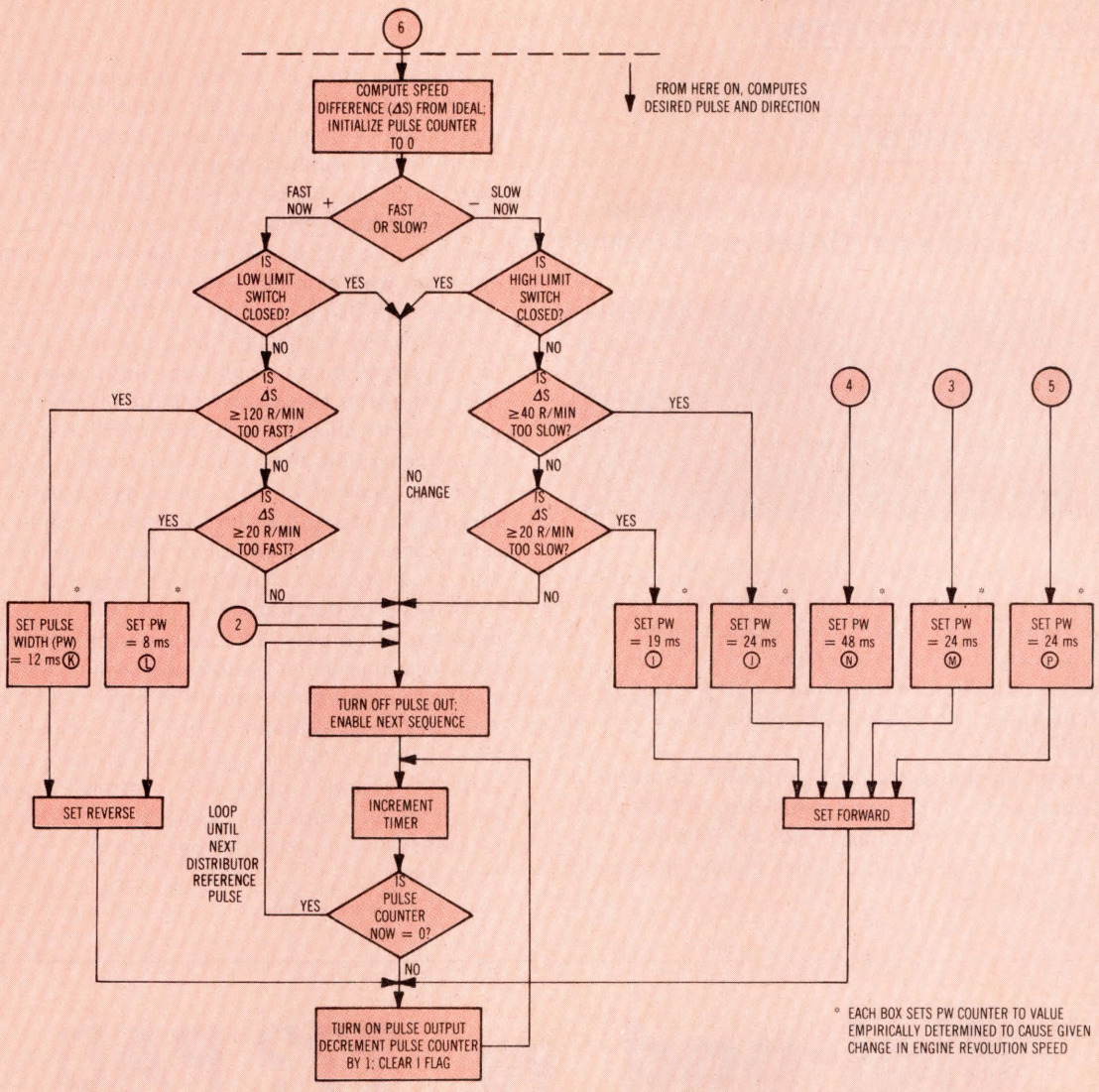


Fig 5 Flow chart for control of engine idle speed. Switch closure inputs from several points throughout vehicle are evaluated by controller, which then sends commands to dc motor mounted on carburetor. Bidirectional motor executes commands to adjust idle speed

toggle one of these signals every 8 to 10 ms or the system will be forced into a bypass/reinitialize mode. This auto restart feature enhances the reliability of the system.

Another Example

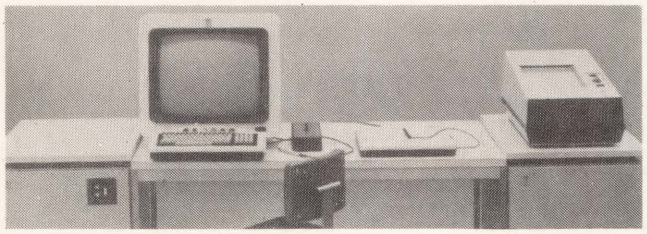
One of the simpler algorithms processed by the MPU is that of controlling engine idle speed via a bidirectional dc motor mounted on the carburetor body (Fig 5). Switch closure inputs are required from the air conditioner, shift lever park/neutral switch, brake pedal, manifold vacuum limit switch (or its equivalent derived by comparing an A-D converter output with a limit parameter), high and low temperature limit switches, low battery voltage detection, throttle-at-rest switch, and maximum and minimum extensions of the idle adjusting screw driven by the dc motor.

Each of these has an effect on operation of the idle speed controller. For instance, switching on the air conditioner or moving the shift lever from park or neutral will cause the engine revolution speed to be increased by ≈50 r/min, in anticipation of the increased load on the engine. This pulse increase is accomplished by output of a 24- or 48-ms pulse, respectively.

Similarly, if while driving at 55 miles/h, the throttle is relaxed to the rest position, engine revolution speed is allowed to drop until a limit condition occurs in the manifold absolute pressure (vacuum). Deceleration is controlled around this point unless the brake is applied, which then allows full deceleration.

DC & AS BRIEFS

Graphics Display and General Purpose Functions Separated in CAD/CAM Terminal



Because one microprocessor is dedicated to the graphics display function and another to communications and peripheral support, the model 795 Digigraphics V has enhanced overall performance characteristics. The interactive, refreshed graphics system from Control Data Corp, Box O, Minneapolis, MN 55440, operates in either local or remote applications.

A basic system includes graphics controller, display unit, ASCII keyboard, and lightpen, and connects to a CYBER 170, 70, or 6000 series host computer via an RS-232-C asynchronous interface. The serial interface can be operated at speeds up to 9600 baud.

Master control of system initialization, interface handling, local data editing, and refresh control, as well as indirect addressing and multiple subroutine methods are provided by the graphics microprocessor. Arithmetic, I/O and logic functions, display refresh, and control programs are in RAM. Basic memory has 32k bytes of 400-ns access time MOS memory. Control of self-test diagnostics, communications between the terminal and host computer, data entry devices, and display instruction file are in P/ROM.

The display is managed by a specialized microprocessor that retrieves instructions from the display file located in RAM, interprets the display instructions, and sends display and control information to the appropriate character and vector generators to produce the graphic image. Hardware function generators save memory space and increase throughput speed. Standard facilities include a vector position generator and a character position generator that provide up to 96 ASCII characters and symbols.

Included in the desktop display unit are a 21" (53.3-cm) diagonal rectangular CRT with a viewable grid of 1024 x 1024 locations and an addressable grid of 2048 x 2048. High contrast images are produced at high writing rates. A solid state keyboard contains a full ASCII set of alphanumeric keys, in conventional typewriter arrangement, including shift and control. A block of 16 control keys provides cursor and terminal control. In addition, a horizontal row of 16 function keys provides programmable, special function operations.

Circle 440 on Inquiry Card

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Active Area	17" (x), 11"(y)	_____
Resolution	0.001"	_____
Accuracy	± 0.005"	_____
Operating Principle	Electromagnetic	_____
Tablet Warranty	2 Years	_____
Tablet Construction	PC Grid with built-in electronics	_____
Digitizing Sensitivity	Thru 1" Thickness	_____
Adjustments	None	_____
Preventive Maintenance	None	_____
Quality	Industrial	_____
Unit Price	$1685*	_____
Micro Option with Graphics Firmware**	Yes	_____

*Consult Factory for OEM Discount Prices
**Additional options include: Power supply, 5 or 16 Button Cursors, X-Y Display, Keyboard

These comparison results are our best sales tool. Dollar for dollar, the performance, reliability and warranty of DIGI-PAD stands unchallanged in the field of low-cost *industrial* X-Ydigitizers. The GTCO DIGI-PAD is your best digitizing investment.



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CIRCLE 59 ON INQUIRY CARD

Finally, a CPU that minds its own business.

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Our new HP 1000 L-Series is designed to give you outstanding processing performance—even in the most demanding applications.

The reason is our innovative distributed intelligence architecture. Each I/O interface has its own processor—made with our exclusive SOS LSI process—and its own direct memory channel. Which means each interface can control and monitor data transfers—without interrupting the central processor.

So the CPU can concentrate on its main job of computation.

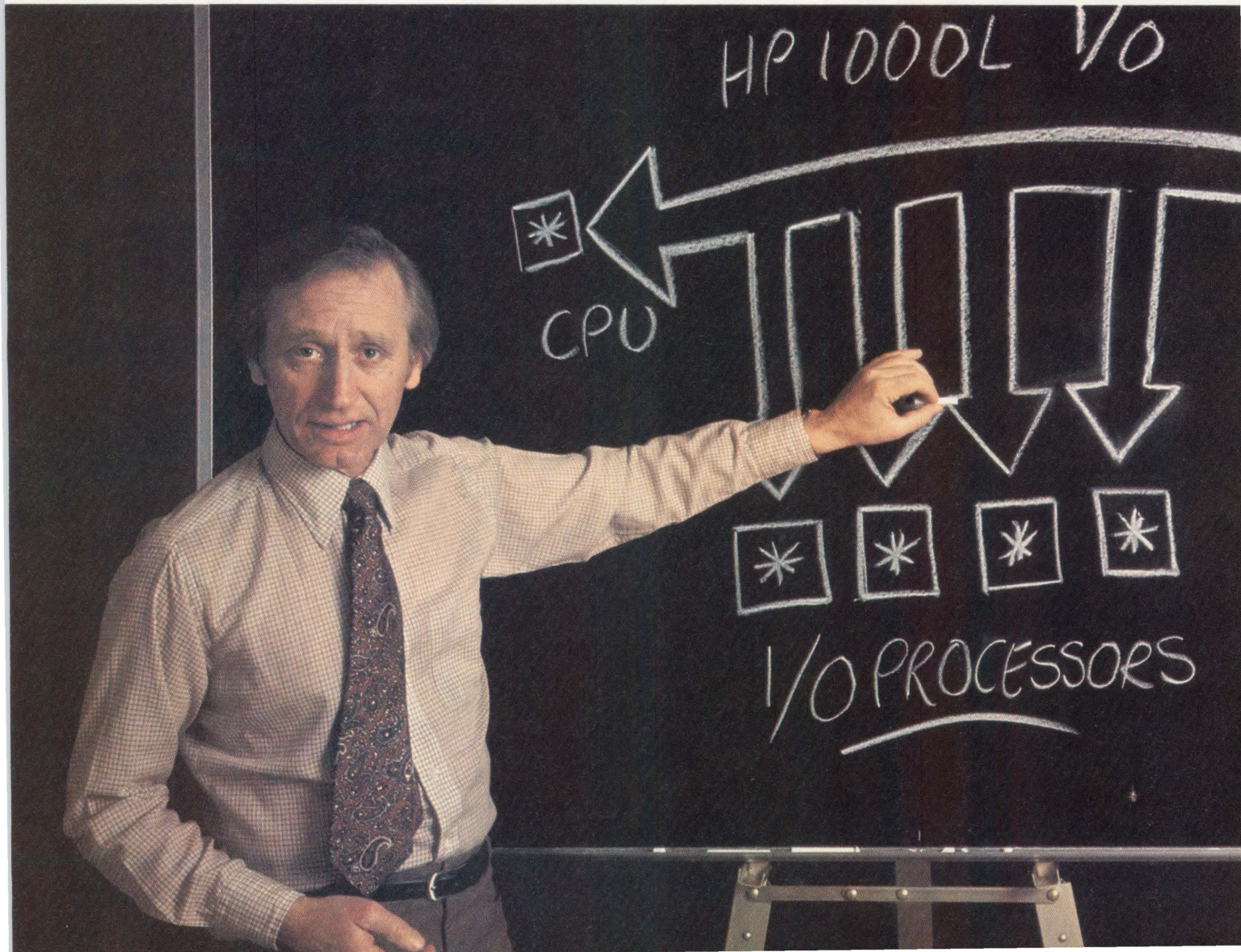
And you get faster response, higher throughput and superior system performance.

But what's really surprising about the L-Series is that you get all this performance at prices that start as low as $1968 for our starter set.† Or $15,510 for a complete disc-based system.††

Nobody makes processors like we do.

The key to the HP-1000 L-Series' impressive new architecture is our own Silicon-On-Sapphire technology. SOS lets us make CPU and I/O chips with extremely high circuit density, low power consumption, high processing speeds and high reliability—at a very low cost.

It's this combination of high performance and low cost that make the L-Series appropriate for the whole range of OEM and industrial appli-



L-Series Computer. CPU concentrate on computation.



cations — including data management, process control and instrumentation.

And to insure you can get the exact configuration you need for your specific application, the L-Series is available in a wide choice of board, box and system packages.

The HP 1000 L-Series is a fully compatible member of our high performance HP 1000 family. Which means you can move up to a larger computer—all the way to our powerful F-Series—as your application grows.

It also means you can use any HP 1000 computer—and its sophisticated program development tools—to design programs for the L-Series.

From $1968



The reliability is built in.

Like all HP computers, the HP 1000 L-Series is designed to give you outstanding reliability. Reliability that's significantly enhanced by our SOS technology — processor boards have fewer active parts, so fewer things can go wrong. In addition, the L-Series has its own self-test programs and diagnostics.

†Starter Set: CPU, 64KB memory, one I/O board.
††Disc-Based System: HP's new 12MB Winchester disc drive and 2621 display console.
(U.S. OEM prices in quantities of 100)

And, of course, the L-Series is backed by our full range of support and documentation services—including our worldwide service network.

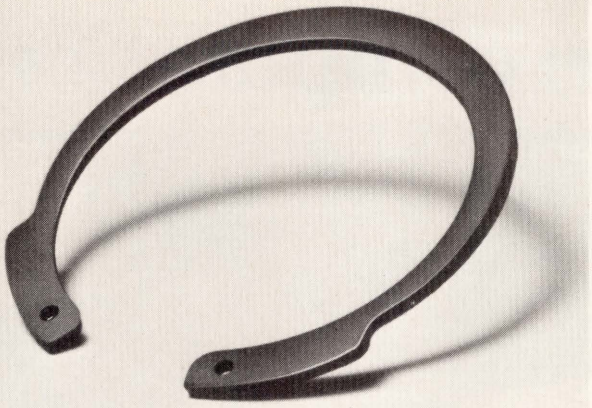
For more information or a hands-on demonstration of our high performance, low cost L-Series, contact your nearest HP sales office listed in the White Pages or write to: Roger Ueltzen, Dept. 1273, 11000 Wolfe Road, Cupertino, CA 95014.

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"Productivity '80: The Computer—Its *New* Role." Hewlett-Packard seminars and practical demonstrations on how to get more from your resources in the coming decade. Watch your local newspaper for details.

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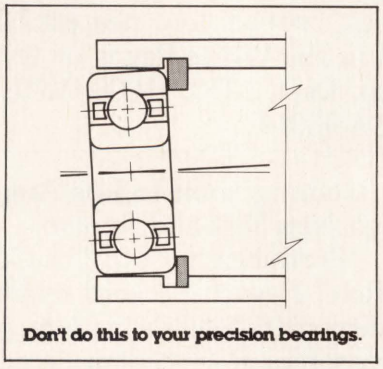
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Realtime Monitoring System Collects Data From 128 Channels

MAx™, a realtime process monitoring system, can collect data from as many as 128 independent, parallel channels without multiplexing. A model 6080 multichannel signal analyzer is combined with dedicated computers by Zonic Technical Laboratories, Inc, 8927 Rossash Rd, Cincinnati, OH 45236, in a building block format. Each data bus handles from two to eight parallel data acquisition channels. Multiple systems can be integrated for large plant monitoring.

In a typical installation, a 20-channel system is monitoring X-Y and thrust signals on a 12k-r/min turbine driven compressor train. Channel signals are simultaneously sampled at up to 64 times/r and transmitted to two data storage discs to build two 5-min moving windows of realtime vibration data. Individual samples are also compared against alarm algorithms, and if preprogrammed alarm combinations are encountered, one disc is frozen, saving 5 min of pre- and post-alarm data.

Circle 441 on Inquiry Card

Voice Response Computer System Collects and Confirms Telephone Orders

TOES (Touch-Talk Order Entry System) answers incoming calls any time of the day or night, prompts the person calling in a 32-word custom vocabulary to obtain required information in a specified sequence, and transfers collected orders to a host computer for processing. Input is via special purpose Touch-Tone® data entry terminals over telephone lines. An IBM Series/1 minicomputer controls the voice response subsystem and collects order information. Modular software provides a number of options to meet specific application requirements. The basic order entry processing system, available from Interface Technology, Inc, 100 Progress Pkwy, Maryland Heights, MO 63043, includes modems, a CRT display station, and a logging printer. Expanded systems can be set up with up to 96 words of voice response and with modems to support up to 32 phone lines.

Circle 442 on Inquiry Card

Industrial I/O Card Interfaces STD BUS

I/O between a STD BUS and industry standard I/O module mounting racks is provided by the 7507 card for control of up to 24 ac or dc input or output modules in any combination and position on an I/O module mounting rack. Available from Pro-Log Corp, 2411 Garden Rd, Monterey, CA 93940, the card works with the Opto-22 PB-8, PB-16A, and PB-24; and Motorola MS8, MS16, and MS24 racks. It can be separated from the mounting rack by up to 10 ft (3 m) of 50-line ribbon cable. Low pass input filters are included for operation in noisy industrial environments.

Circle 443 on Inquiry Card

From concept...to prototype...to production. Faster. With Multiwire® circuit boards.

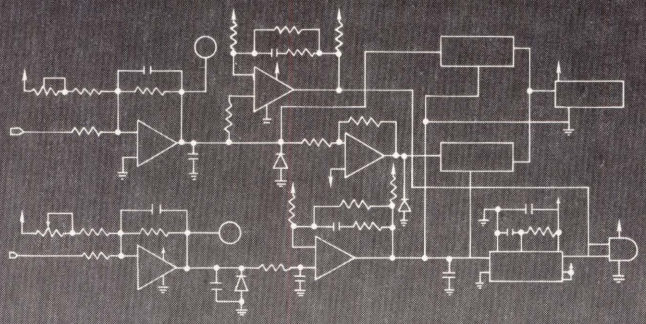
Just give us a net list and board layout. You'll get a computer-generated design, prototypes, and delivery of production boards in a fraction of the time you would expect.

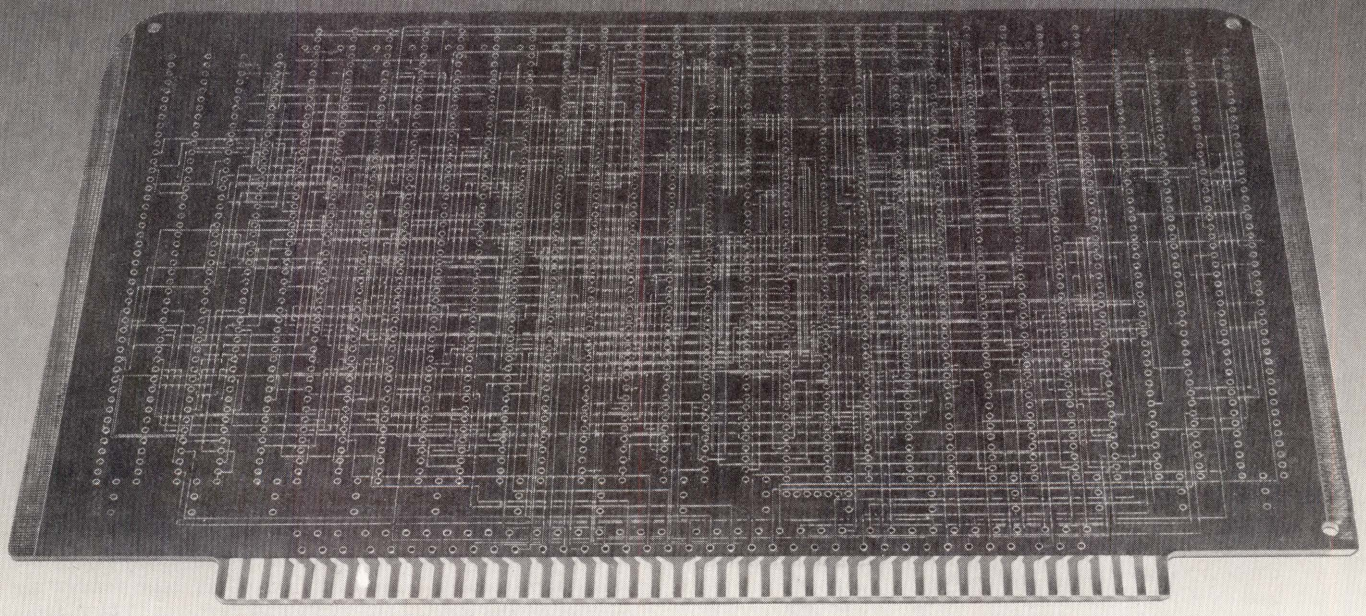
The Multiwire process is simply *faster* than multilayer . . . all the way from board design through manufacture to function. Especially working with high density interconnects.

A Multiwire circuit board is a pattern of insulated wires bonded to an epoxy glass substrate by a high-speed CNC machine, and terminated by plated through holes. It offers greater control of electrical characteristics, improved reliability, higher density, and fast changes for component updates and ECO's.

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Licenses to design and manufacture Multiwire circuit boards are available from PCK Technology Division, Kollmorgen Corporation, 31 Sea Cliff Avenue, Glen Cove, NY 11542. Phone: (516) 448-1166.

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Programmable Instrumentation Amplifier Has 5-μs Settling Time

A hybrid instrumentation amplifier featuring ultrafast settling times and programmable gain settings, the LH0084 is specifically designed for high speed multiplexed data acquisition systems. Settling time to 0.01% is 5 μs, which according to National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95051, is about 10 times faster than for other PIAs. Input impedance of the 16-pin device is 10^{11} Ω. Fabricated in two sections, the first section contains a pair of digitally programmable variable gain amplifiers with FETs at each input. These are followed by a differential to single-ended output stage with pin programmable gain. The input stage is software programmable via the film resistors for gains of 1, 2, 5, or 10, while the output stage is pin-strapped to yield gains of 1, 4, or 10,

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CUT-THROUGH PROTECTION.

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Interface Cards Expand Measurement/ Control System Functions

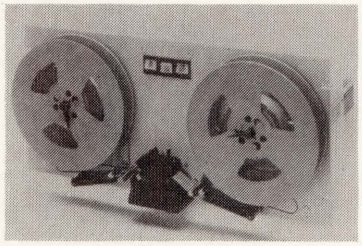
Interface cards introduced by Analog Devices, Inc, PO Box 280, Norword, MA 02062, for the MACSYM 2 and 20 measurement and control systems include the AIM04, a 16-channel flying capacitor multiplexer board with programmable gain amplifier; the AIM05, a 4-channel strain gage board; and the FIN01 and FIN02, 8- and 16-channel frequency counter cards.

Reed relays in the AIM04 implement the flying capacitor multiplexing function, enabling the user to make differential measurements in the presence of high common mode voltages of up to 250 V rms; 16 differential channels can be sampled at the rate of 130 samples/s with ±0.01% linearity. Software programmable gains of 1, 16, or 256 are available. The 4-channel AIM05 provides bridge completion resistors, excitation supply, calibration resistors, and DIP-switch selectable gain of 1 or 128 for each channel. One, two, or four arm bridges can be interfaced and excitation voltages of 5 and 10 V individually selected via DIP switches. FIN01 and FIN02 measure frequencies from 1.6 Hz to 1 MHz with 0.1% resolution. Both boards feature Schmitt-trigger circuitry with four user selectable hysteresis levels that allow accurate frequency measurement in the presence of noise.

Circle 444 on Inquiry Card

Paper Tape Reader Introduced For Computer Numerical Control

A 200-char/s asynchronous or synchronous read speed and a 400-char/s tape positioning mode for rewinding on program cueing are features of the RR7155 paper tape reader announced by the Remex Div of Ex-Cell-O Corp, 1733 E Alton St, Irvine, CA 92713. Intended to meet requirements of the computerized numerical control and program load market, the reader is 5.5" (14 cm) high and mounts in a 19" (48-cm) rack. An optional add-on fanfold tank assembly is available. MTBF is 16,000 to 20,000 h. Operating life is extended by the use of an LED phototransistor read head. Operation is from 47 to 63 Hz at 115 V, 1.0 A and 230 V, 0.5 A.



Circle 445 on Inquiry Card

CIRCLE 64 ON INQUIRY CARD

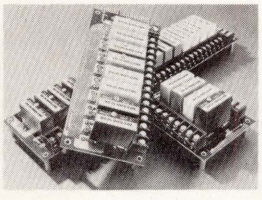
Data Acquisition System Monitors Power Distribution Networks

A 15-channel unit based on an 8085 microprocessor, the model 1600 electronic recording and data acquisition system is designed specifically for locating and monitoring faults on power distribution networks. Battery backup is provided for the 110/220-V primary power. Data are recorded from three current and three voltage plus eight digital inputs. In addition, the unit records an internally derived signal representing the imbalance on a 3ϕ system. Eight total fault events can be recorded on a single tape. In fault mode, the unit records 10 ms of data prior to the trigger point at 40 kHz, 2 ms of data subsequent to the trigger at 40 kHz, 70 ms of data at 4 kHz, and 1 s of data at 250 Hz, for each channel and for each reclosure. The system was developed by Macrodyne, Inc, 153 Princetown Rd, Schenectady, NY 12301, under contract to the Electrical Power Research Institute of Palo Alto, Calif, in conjunction with Power Technologies, Inc, of Schenectady, NY.

Circle 446 on Inquiry Card

I/O Modules Provide Bidirectional Controller-Load Interface

TTL, CMOS, NMOS, PMOS, and switch logic compatible control systems made up of socketed PC boards that hold 4, 8, or 16 fully encapsulated I/O modules are available for 5-, 15-, and 24-V logic systems. Logic circuit connections are made with edge connectors. Systems and modules, introduced by Hamlin, Inc, Lake & Grove Sts, Lake Mills, WI 53551, provide bidirectional interface between microprocessor or microprocessor based process controllers and loads of up to 3 A on 240 Vac or 200 Vdc. 2500-Vac isolation meets UL industrial control specifications, and ac output modules have zero voltage turn-on. All modules have a -40 to 80 °C temperature range as well as high transient and noise immunity, and are protected against line surges. Each module position on a board has an LED status indicator for programming, setup, and troubleshooting.



Circle 447 on Inquiry Card

Digital Pickup Immune to Industrial Electrical Noise

Combining solid state circuits and Hall effect principles, the model 4-0063 zero velocity digital pickup attains immunity to noise caused by 800-V transients generated by a NEMA Class 1 relay, uhf radiation of 4 W at 462 MHz and a distance of 2 ft (0.6 m), and noise pulses at ±100 to 800 V peak. With stainless steel housing, it operates at temperatures from -25 to 80 °C. Output is solely dependent on position of the gear teeth or other ferrous discontinuity. Velocity of the gear teeth passing the sensor has no effect. Available from Airpax, 6801 W Sunrise Blvd, Ft Lauderdale, FL 33313, the pickup meets all present TTL design standards and can feed a square wave fanout of up to 10 TTL inputs, 50 ±10% duty cycle.

Circle 448 on Inquiry Card

KYNAR® gives you another advantage.

CHEMICAL RESISTANCE.

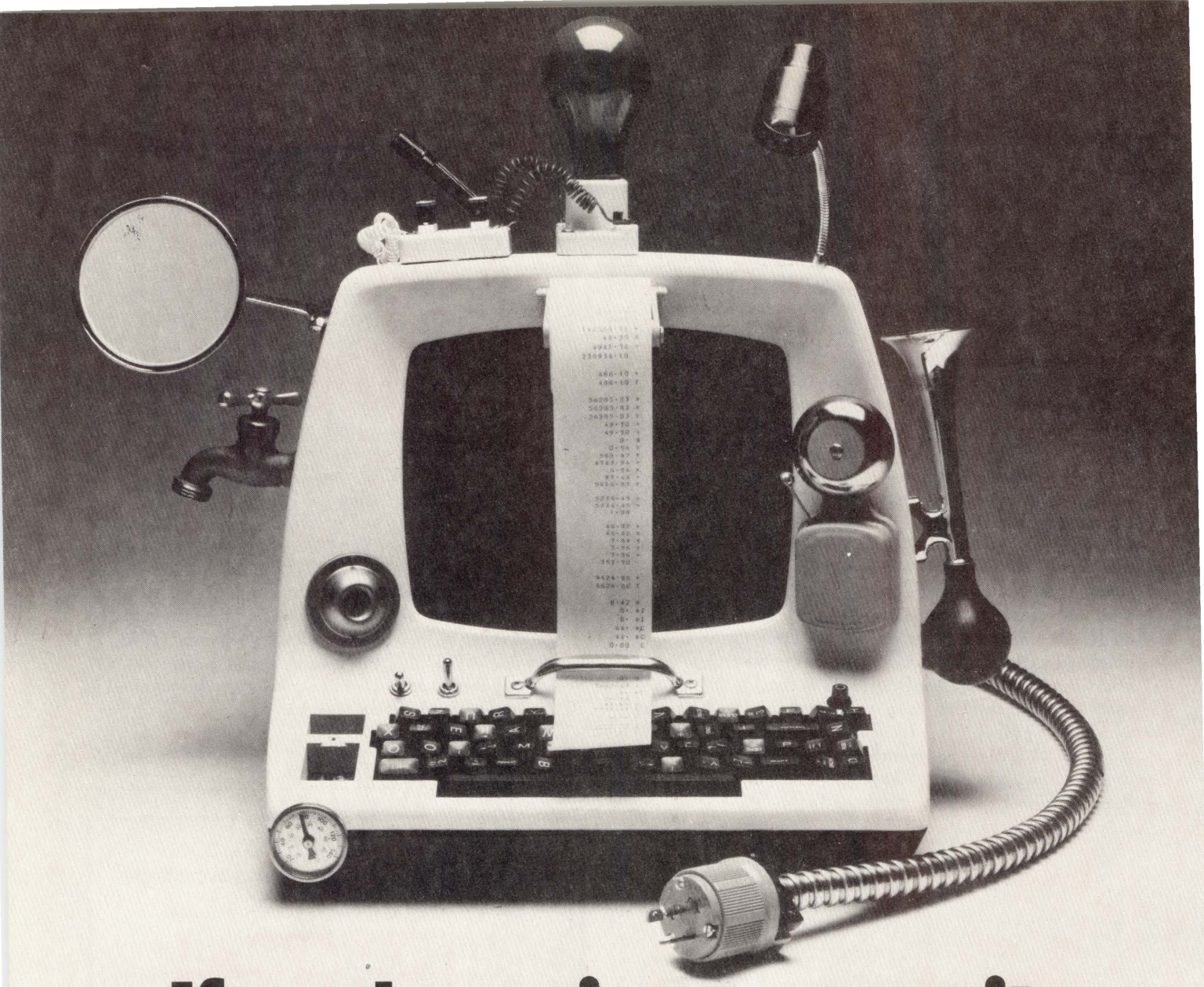


KYNAR PVDF was born to handle solvents and corrosives in chemical plants. You get that protection in KYNAR wire insulation. Resists UV and nuclear radiation, too. Get full information. Write KYNAR, Pennwalt Corporation, Three Parkway, Philadelphia, PA 19102. Or call (215) 587-7514.

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CIRCLE 65 ON INQUIRY CARD



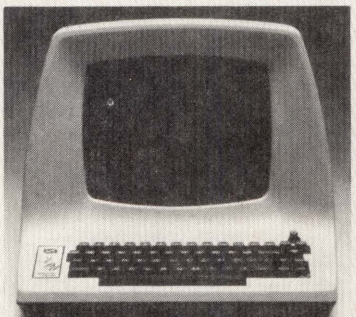
If you're going to copy it, at least do it right.

You see them every day.

Copycat terminals, with flashy features, all claiming to be as good as the renowned Dumb Terminal® video display terminal. Some even claim the same reliability that made the Dumb Terminal a household word.

But none can claim the ADM-3A's field-proven average of 15 months between service calls. Which means you spend less time and money on repairs. That's why the Dumb Terminal has become the industry standard—and why we've sold over 100,000 of them. It makes us feel that our extensive burn-ins and grueling quality control have been worth it.

We didn't load the Dumb Terminal with fancy frills—just dependable features that get the job done. Like a 12" diagonal screen, full or half duplex at 11 selectable data rates (75-19.2K baud), 1920 characters in 24 rows of 80 letters, RS232C extension port, and direct cursor addressing. Plus a host of sensible options. All for just $895.



DUMB TERMINAL. SMART BUY.

So don't be fooled by Dumb Terminal imitations. Because there's simply no substitute for Dumbness.

Lear Siegler, Inc./Data Products Division, 714 N. Brookhurst Street, Anaheim, CA 92803, 800/854-3805. In California 714/774-1010. TWX: 910-591-1157. Telex: 65-5444. Regional Sales Offices: San Francisco 408/263-0506, Los Angeles 213/454-9941, Chicago 312/279-5250, Houston 713/780-2585, Philadelphia 215/245-1520, New York 212/594-6762, Boston 617/423-1510, Washington, D.C. 301/459-1826, England (04867) 80666.

LEAR SIEGLER, INC.
DATA PRODUCTS DIVISION

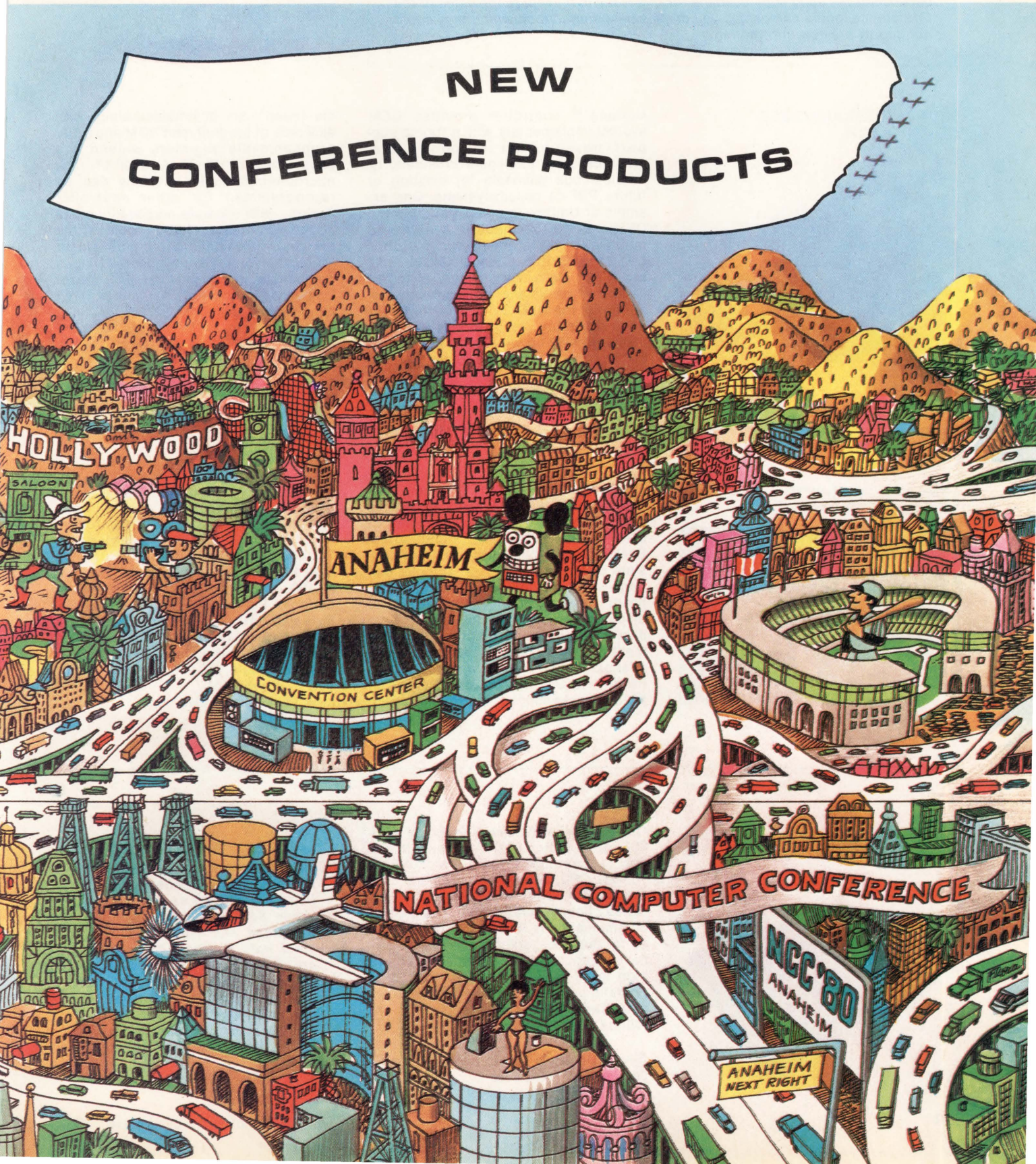
Dumb Terminal® is a registered trademark of Lear Siegler, Inc.

CIRCLE 66 ON INQUIRY CARD

COMPUTER DESIGN

THE MAGAZINE OF
COMPUTER-BASED SYSTEMS

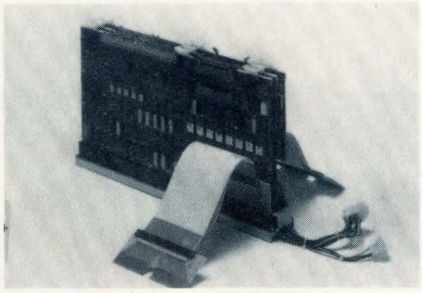
PREVIEWS



NCC PRODUCT PREVIEW

Computer Design *asked most NCC'80 exhibitors to supply advance information on truly new products to be introduced to attendees at the Conference. To the best of our knowledge, the following 82 are such products. However, because of the early copy deadline for this issue in respect to the dates of the Conference, some companies will display new products on which they could not supply preview information.*

MICROPROGRAMMABLE CONTROLLER

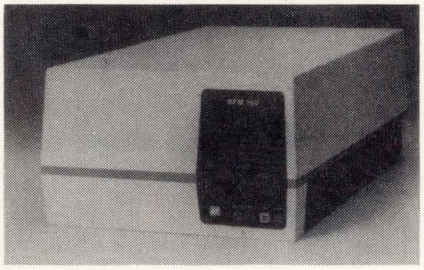


Uniface™ controller provides OEM system implementers with a tool to support development of controllers, preprocessors, intelligent channels, or multiple bus channels for existing or future PDP-11 based systems. One example of Uniface implementation is the DV/16 8- to 32-channel sync/async multiplexer replacement for the DEC DV11; the DV/16 can be installed in 2 to 7 std SPC slots versus the 9 to 18 dedicated backplane slots currently required by the DEC DV11. The controller uses bit-slice technology and implements a 32-bit wide microword as an instruction set. A 200-ns instruction cycle speed (user adjustable), along with 4k words of programmed ROM and other programmable registers extend the capabilities of the host PDP-11. The microprogrammable interface can be reprogrammed for other controller designs with separate personality cards added to create Unibus compatible devices, implement 1 or more intelligent Unibus selector channels, install Unibus compatible preprocessors, and create Unibus adapters. **Able Computer,** 1751 Langley Ave, Irvine, CA 92714.

See at Booth 3411

Circle 525 on Inquiry Card

90M- AND 158M-BYTE WINCHESTER DRIVES

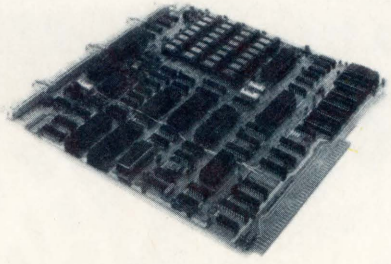


Centennial Series of 14″ (36-cm) Winchester disc drives consist of BFM-90 and -160 with respective capacities of 90M and 158.6M bytes unformatted. Sealed module head/disc assembly consists of a rigid deckplate, spindle, carriage/way assembly, 3 or 4 discs, R/W heads, and a servo head. Heads and discs are tested as a single assembly to eliminate interchangeability or misalignment problems, as well as possibility of mistracking or data checks. Two data heads read and write the top disc, and up to 3 double-headed assemblies each read and write the bottom surface of 1 disc and the top surface of another. Power supply, servo, digital control, interface, and R/W control are carried on 5 PC boards. Recording density of both drives is 6486 bits/in (2554/cm). There are 20,160 bytes/track, with 1122 tracks/surface. Format is SMD compatible. Bytes/sector and sectors/track are variable. **Ball Computer Products Div, Ball Computer Products,** 860 E Arques Ave, Sunnyvale, CA 94086.

See at Booth 2408

Circle 526 on Inquiry Card

SINGLE-BOARD MICROCOMPUTER



On one 144-in² (936-cm²) PCB the TCB-85E offers option of 64k-bytes RAM and can accommodate Intel's 8085A-2 10-MHz CPU, as well as peripheral controllers for CRT and keyboard, dual-density floppy, parallel printer, and serial communications. The boards are designed for business, scientific, and text processing applications with the support of high level Pascal as well as the CP/M operating system. **Digitron Optical Scanning Corp, OEM Products Div,** 175 I U Willets Rd, Albertson, NY 11507

See at Booth 3419

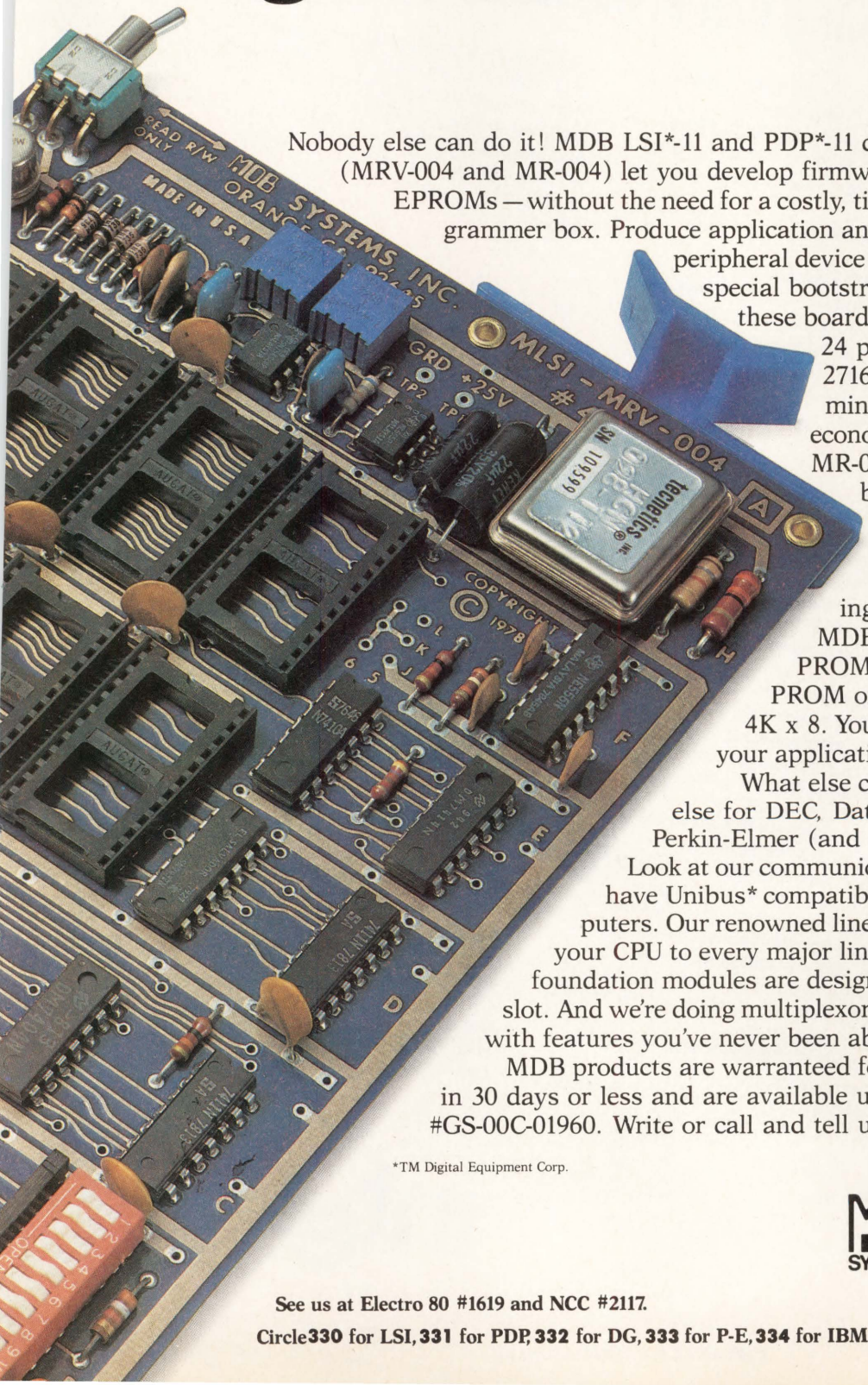
Circle 527 on Inquiry Card

NOTE

1000 series booths are located in North Hall at the Anaheim Convention Center, 2000 series numbers are in South Hall, 3000 series in the Arena, and 4000 series in the West Hall. Booths 1 through 178 are part of the Personal Computing Festival and are located at the Disneyland Hotel Convention Center. Booths 201 to 999 are NCC exhibitors that are located in the Disneyland Hotel Lower Level Exhibit Hall.

MDB makes modules that let you program PROMs on the board.

Imagine what else we can do!



Nobody else can do it! MDB LSI*-11 and PDP*-11 compatible plug-in boards (MRV-004 and MR-004) let you develop firmware internally—up to eight EPROMs—without the need for a costly, time consuming external programmer box. Produce application and bootstrap programs, replace peripheral device loading in small systems or do special bootstrap loading in large systems—these boards will allow programming of 24 pin EPROMs ranging from the 2716 to the 2732. After programming, you can also transfer to the economical MDB MRV-005 and MR-005 ROM modules. These unique boards let you combine RAM, ROM and PROM for maximum systems flexibility.

And MDB's problem solving doesn't stop there—because MDB makes a complete line of PROM boards with every kind of PROM organization from 256 x 4 to 4K x 8. You'll find the one you need for your application.

What else can we do? More than anyone else for DEC, Data General, IBM Series/1, Perkin-Elmer (and sometimes HP) computers. Look at our communications modules—we even have Unibus* compatible interfaces for Q-bus* computers. Our renowned line of controllers will interface your CPU to every major line printer in the world. MDB foundation modules are designed to use only one card slot. And we're doing multiplexors and interprocessor links with features you've never been able to get before.

MDB products are warranteed for a full year, delivered in 30 days or less and are available under GSA contract #GS-00C-01960. Write or call and tell us what we can do for you.

*TM Digital Equipment Corp.

MDB SYSTEMS INC.
1995 N. Batavia Street
Orange, California 92665
714-998-6900
TWX: 910-593-1339

See us at Electro 80 #1619 and NCC #2117.

Circle 330 for LSI, 331 for PDP, 332 for DG, 333 for P-E, 334 for IBM.

The Intel Notebook

Careers and Technology at Intel

Portland, Oregon: Intel is moving fast in the Northwest

For the past three years we've been growing at an incredible rate in the Portland area.

We're not the new kid on the block anymore. Oregonians are beginning to recognize us for what we are: the most innovative microelectronics company in America.

And a good company to work for—with a big future.

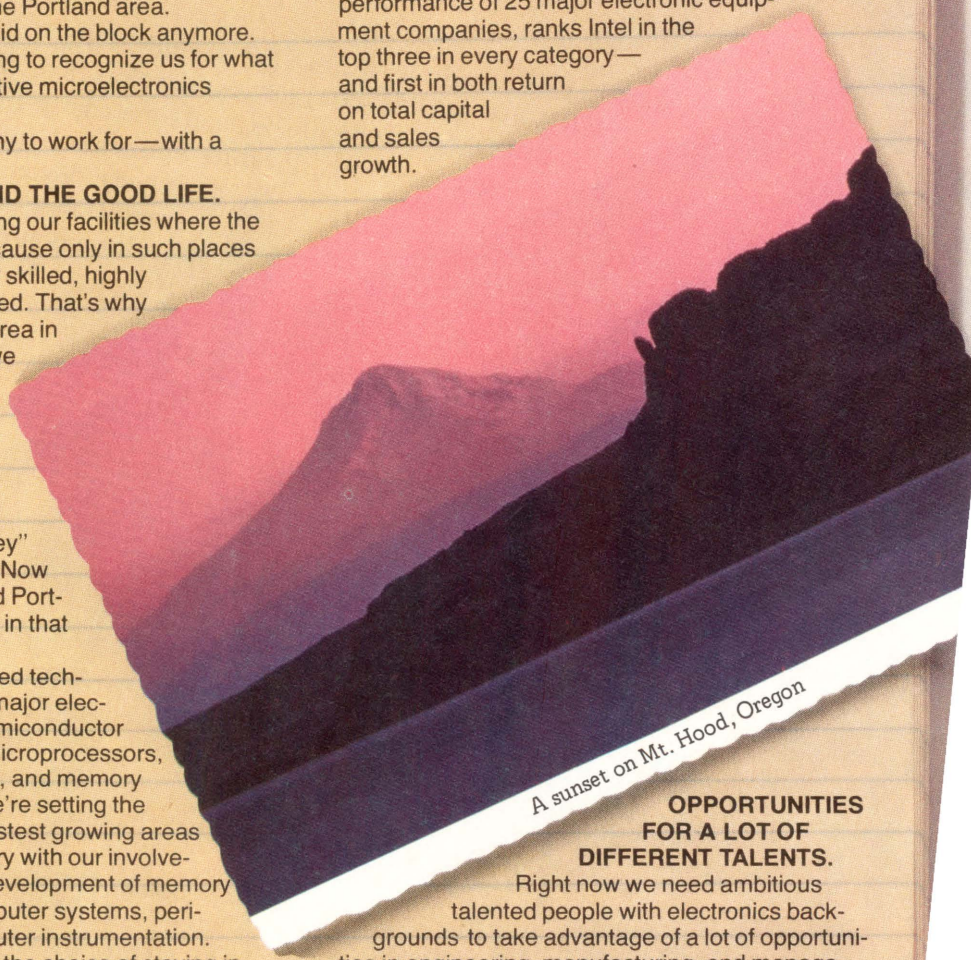
TECHNOLOGY AND THE GOOD LIFE. We're interested in putting our facilities where the quality of life is high, because only in such places can we attract the highly skilled, highly motivated people we need. That's why we chose the Portland area in the first place and why we intend to expand there.

Just a few years ago, in order to pursue a career in the semiconductor industry, you practically had to live in California's "Silicon Valley" south of San Francisco. Now you have a choice—and Portland figures prominently in that choice.

Intel is the recognized technological leader in four major electronic product areas: semiconductor memory components, microprocessors, microcomputer systems, and memory systems. In Portland, we're setting the pace in several of the fastest growing areas of the electronics industry with our involvement in the advanced development of memory components, microcomputer systems, peripherals and microcomputer instrumentation.

So we can give you the choice of staying in Portland if you're already a resident, or moving here if the beauties of the Northwest appeal to you *and* at the same time, you'll enjoy working at the leading edge of electronic technology.

GROWTH AND STABILITY. Intel is not only one of the fastest growing companies in the world, it is one of the most financially stable in the entire electronics industry. *Forbes* magazine, measuring the profitability and growth performance of 25 major electronic equipment companies, ranks Intel in the top three in every category—and first in both return on total capital and sales growth.



A sunset on Mt. Hood, Oregon

OPPORTUNITIES FOR A LOT OF DIFFERENT TALENTS. Right now we need ambitious talented people with electronics backgrounds to take advantage of a lot of opportunities in engineering, manufacturing, and management. People who want to stay in Portland and people who want to move here. Even people who would rather live in California, Arizona, or Texas.

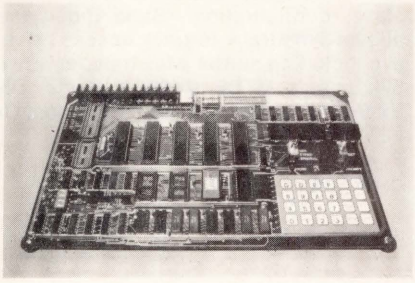
Send your resume now to our Employment Department, Intel Corporation, Dept. 18 AR, 3585 S.W. 198th Avenue, Aloha, OR 97007. An equal opportunity employer m/f/h.

intel®

CIRCLE 68 ON INQUIRY CARD

NCC PRODUCT REVIEW

MICROCOMPUTER PROGRAM DEVELOPMENT SYSTEM



F387X PEP (Prototyping, Emulation, and Programming) single-board microcomputer is a program development station, test and debug tool, and prototype emulator for F8 and F3870 microcomputer families. Adding a macro assembler software package turns the system into a PEP-UP system, designed for users of Intel development systems. F8 and F3870 software can be developed on an existing Intel system, then downloaded to the PEP board for realtime debugging and emulation. The unit includes programming sockets for F38E70 and 2716 EPROMs, an onboard keypad for command and data entry, onboard 7-segment address and data displays, and a 40-pin emulation cable. The board has 2k bytes of 2114 static RAM with space for an additional 2k bytes and up to 6k bytes of 2716 EPROM. Other features are the PEPBUG 2k-byte firmware monitor, crystal controlled system clocks, general purpose programmable timers, and interrupt controls. **Fairchild Camera and Instrument Corp,** 464 Ellis St, Mountain View, CA 94042.

See at Booth 2752

Circle 528 on Inquiry Card

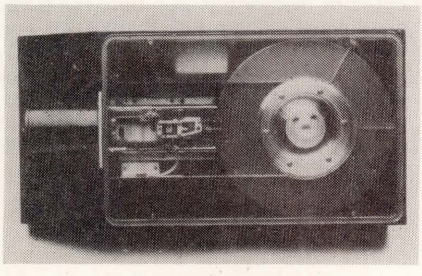
MODEMS, MULTIPLEXERS, AND DATA SETS

GDC 202S type 21 1200-bit/s and MP208B/A 4800-bits/s modems are FCC registered, Bell compatible devices. Both have comprehensive diagnostics. The former, designed for half-duplex, switched network operation, features originate and answer modes, and compromise equalizer to compensate for both amplitude and delay distortion. It is compatible with Western Electric 202S, 202C, and 202E modems. The latter, a microprocessor based synchronous modem, is a direct replacement for Western Electric 208B modems. Features include digital filters, eye pattern generator, and automatic adaptive equalizer which permits use over telephone lines with large variations in transmission characteristics. The company's TDM 1240 statistical time division multiplexer can achieve a multiplexing efficiency of 200% typ. Efficiencies to 400% are achievable in networks with low data activity. Features include multiplexing for 4 channels, aggregate rate to 9600 baud, synchronous or asynchronous operation, dynamic buffer allocation, variable framing, and system diagnostics and status indicators. The 202S/T data set is online compatible with Western Electric 202 type sets; the FCC registered data set receives binary serial data at rates to 1200 bits/s over the switched network and to 1800 bits/s over private lines. Compatible with Western Electric 212A type data sets, the 212A transmits and receives binary data at rates to 1200 bits/s over the switched network. **General DataComm Industries, Inc,** 1 Kennedy Ave, Danbury, CT 06810.

See at Booth 1139

Circle 529 on Inquiry Card

8″ FIXED DISC DRIVES



Suited to multi-user, multitasking applications, the 6170 series of 210-mm fixed disc drives feature a linear voice coil actuator operating in a closed loop servo system; brushless dc spindle motor; and sealed data module with closed loop recirculating air system. Actuator and drive motor are located outside the sealed module environment to avoid heat build-up and to extend product life. Average time to data of the Winchester 3350 type drives is 50 ms. Circuitry eliminates user mapping of media imperfections. Data transfer rate is 800k bytes/s and MTBF is 10,000 h (25,000 h for the sealed module). The 24M-byte model 6172 and the 8M-byte model 6171 are available with a choice of interfaces: SMD, Disk Bus, or Host Bus with integral controller formatter. No operator intervention is required for drive operation. **BASF Systems, Div of BASF Wyandotte Corp,** Crosby Dr, Bedford, MA 01730.

See at Booth 2707

Circle 530 on Inquiry Card

C COMPILER FOR 6800 MICROPROCESSOR

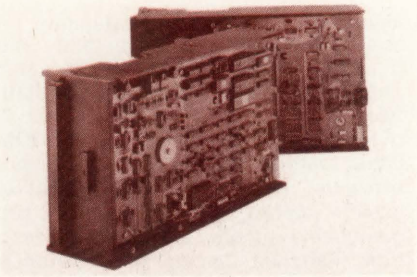
Including features described in *The C Programming Language,* the compiler is intended to run under the WIZRD multitasking disc operating system on the SPRINT 68 microcomputer. A structured general purpose programming language, it is used for operating systems and numerical text processing, and database programs. Relatively small and compact and easy to learn, C provides pointers and the ability to do address arithmetic. Any function can be called recursively and its variables declared in a block structured fashion. Variables may be internal, external, or global. Functions can be compiled separately. Because it deals with the same sort of objects that microcomputers do—characters, numbers, and addresses—these can be combined and moved efficiently using 6800 arithmetic and logical operations, making the language efficient in the amount of code generated. **Wintek Corp,** 1801 S St, Lafayette, IN 47904.

See at Booth 1465

Circle 531 on Inquiry Card

NCC PRODUCT PREVIEW

DUAL-HEAD DISKETTE DRIVE WITH INTELLIGENT CONTROLLER

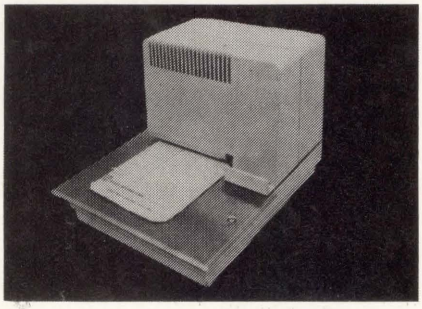


With an intelligent, IBM compatible double-density controller/formatter on the board with drive electronics, RFS 4800 subsystem allows a complete high performance dual-head subsystem to be housed in the space of a std drive. In addition, the interface is organized around an 8-bit bidirectional data bus for efficient systems integration. Drive incorporates unique head referencing design, FRP base material to achieve temperature expansion coefficients commensurate with diskette, an R-C circuit on loading solenoid to control head delivery, and an improved band positioning technique. The IBM 6800 microprocessor based onboard controller makes it possible to read and write data on both sides of an 8″ (20-cm) 2D or equivalent diskette in 8 double-density and 5 single-density formats. Up to 3 drives can be daisy chained in a master-slave configuration. Band positioner allows 3-ms track to track access (91-ms avg including settle). Max transfer rate is 57k bytes/s. MTBF is 8000 h. **Remex Div, Ex-Cell-O Corp,** 1733 Alton St, Irvine, CA 92713.

See at Booth 3001

Circle 532 on Inquiry Card

SINGLE-STATION ALPHANUMERIC SLIP PRINTER



Basic print mechanism of model MS-4000, a mechanically driven dot matrix printhead, prints 40 char at 12 char/in (4.8/cm) at a speed of 2 lines/s. It accommodates various size slips and forms. The compact, alphanumeric, single-station slip printer mechanism has in-flight bidirectional print capability. Slip insertion can be from either the left side or front; a slip stop provides front insertion only. Independent paper friction feed is cam operated. **Westrex OEM Products,** 1140 Bloomfield Ave, West Caldwell, NJ 07006.

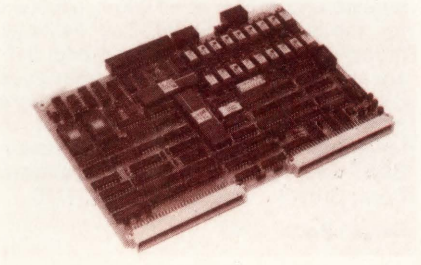
See at Booth 1301

Circle 533 on Inquiry Card

NOTE

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HIGH PERFORMANCE MICROCOMPUTER BOARD



Designed for uses requiring extensive computer power, access to a large memory space, and high speed serial communication capability, the Z8000-MPU board can function either as a standalone single-board microcomputer or as the master in a set of several peripheral boards. Components are 32k bytes of onboard RAM with parity protection, 8k bytes of additional ROM or P/ROM space, 2 flexible communication channels, and a realtime clock for managing multitasking software environments. The Z8001 CPU, a segmented microprocessor characterized by a powerful 414-member instruction set, permits the user to address up to 8M bytes of memory. In addition, the board employs the Z80A-SIO (serial I/O) controller. Other board features include a parity-error detection circuit, pin and socket connectors, 3 types of interrupts, and 3 LED displays for system status indication. **Zilog, Inc,** 10340 Bubb Rd, Cupertino, CA 95014.

See at Booth 4301

Circle 534 on Inquiry Card

COMPACT HARDCOPY PRINTER

Designed to reproduce exactly the CRT display on the Epiview and Episolver data communications analyzers, model Ei 430 weighs 35 lb (16 kg) and measures 18 x 16.6 x 7″ (46 x 42 x 18 cm). The portable printer is suitable for field use as well as slide rackmounting for central site applications. Reproduction of the CRT screen is positioned on an 8.75 x 11″ (22 x 28 cm) section of thermal paper, with 0.1 x 0.13″ (0.25 x 0.33-cm), 11 x 14 dot pattern characters in approx 45 s. The resultant printout distinguishes between transmitted and received data, provides for reverse imaged characters, and also indicates parity and framing errors. A built-in test capability produces an easily verifiable printed pattern to exercise all of the printer's mechanical and drive functions and more than 90% of the logic functions. **Epicom, Inc,** 592 N Douglas Ave, Altamonte Springs, FL 32701.

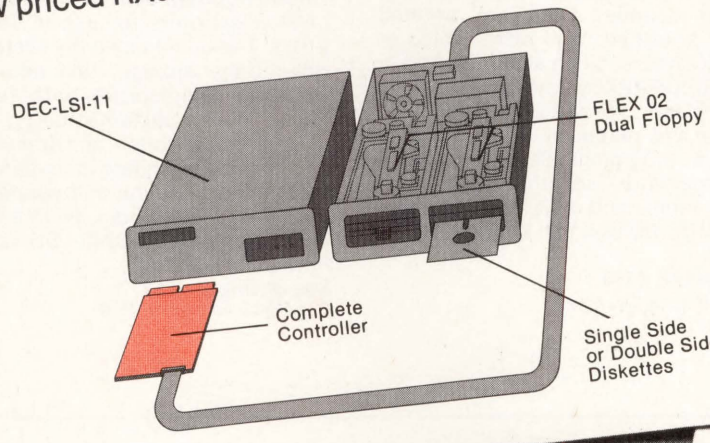
See at Booth 4147

Circle 535 on Inquiry Card

FOUR NEW CARDS FOR YOUR DEC...

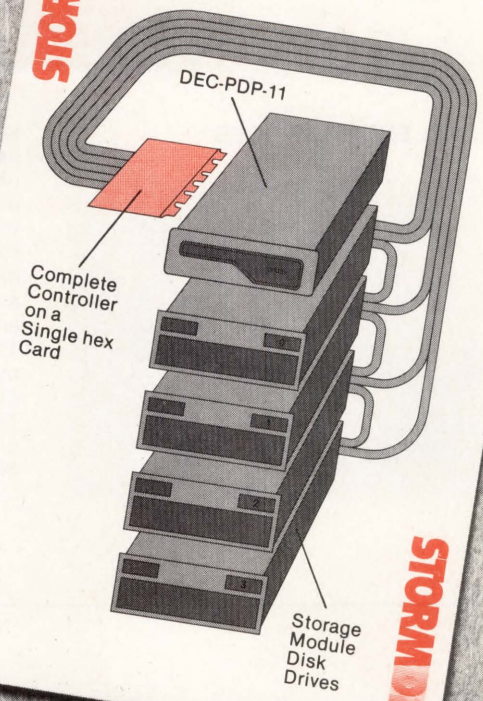
Low priced RX02 emulator

FLEX02



Single card RM02 emulator

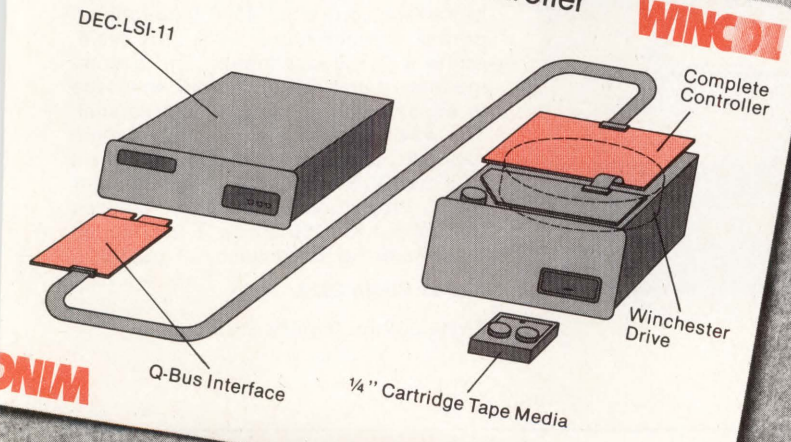
STORM02



STORM02

RL01 compatible Winchester controller

WINC01

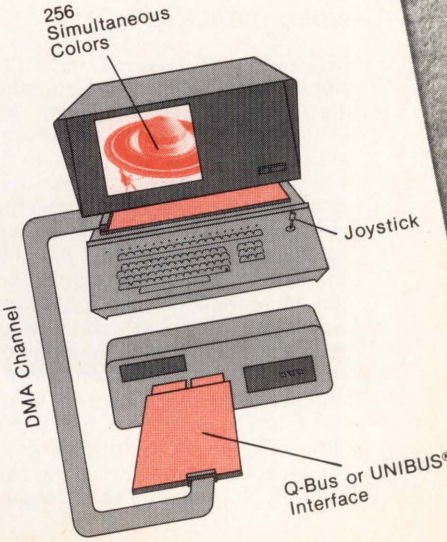


FROM AED

Our three new low-cost emulator controllers provide OEMs with greater flexibility, improved reliability and better thruput for their LSI-11 and PDP-11 based systems. At a price/performance ratio that aces out all the competition! Add to this the AED512, our full-color graphics imaging system, and you'll see why AED has all the cards you need.

Full color imaging system

AED512



Controller features

FLEX 02...complete RX02 emulation on a dual-width card that plugs directly into any LSI-11, media compatibility, uses DEC-provided software, available with DEC look-alike 2-drive cabinet, runs RX02 diagnostics, compatible with Q-Bus® and comes with single or dual-head drives.

WINC 01...controller card mounts directly onto Winchester drive, dual-width interface card plugs into any LSI-11 computer, runs RL01 diagnostics, fixed media reliability, microprocessor based, built-in error correction, compatible with Q-Bus® and comes with 15 MB cartridge tape drive for data transportability.

STORM 02...full RM02 emulation on single hex card for a PDP-11, runs RM02 driver software unaltered, has pack interchangeability with DEC, compatible with Ampex, Ball, Century Data or CDC storage module drives and provides data transfer at 1.209 MBs/sec. @ 3600 rpm.

* Reg. trademark of Digital Equipment Corp.

ADVANCED ELECTRONICS DESIGN, INC.

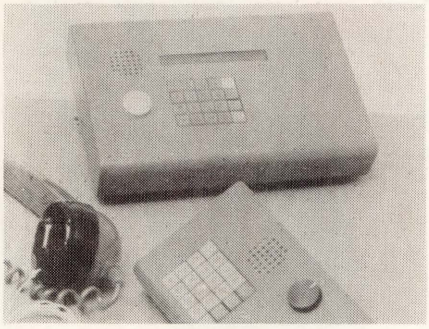
COMPUTER PERIPHERALS DIVISION

440 Potrero Avenue, Sunnyvale, CA 94086 Phone 408-733-3555, Boston 617-275-6400

CIRCLE 69 ON INQUIRY CARD

NCC PRODUCT PREVIEW

DATA ENTRY DEVICES



Stargate 1 consists of a data entry device which links to a remote central processor via telephone line and acoustic coupler. Data are entered through a keypad, with either voice or tone response, and can also be linked to an IBM 3750 PABX system. Stargate 11 is a hardwired version with built-in amplifier and response, while Stargate 111 is a programmable version with microprocessor control which will display, store, and edit data. **Modular Technology,** PO Box 117, Watford, Herts, England.

See at Booth 4114

Circle 536 on Inquiry Card

TELECOMMUNICATIONS BUFFER MEMORY SYSTEMS

Telex-34 buffers convert the TTY 43 and LA34 teleprinters for use in Telex networks. The built-in memory systems provide offline storage, text editing, and ability to communicate with Telex stations. They automatically handle character translation and transmission, and provide standard communications protocols for dialing and connecting to the Telex network services. **Edge Technology Inc,** 3743 SE 21st St, Portland, OR 97202.

See at Booth 4253

Circle 537 on Inquiry Card

IBM/ANSI COMPATIBLE RECORDER

Used with any mini or microcomputer system, the SCDR-1050 adds 10s of megabytes of data storage for batch processing, programmed information distribution, archival storage, and disc backup. The microprocessor controlled 0.5″ (1.2-cm) magnetic tape system provides 1600-char/in (630/cm) PE and/or 800-char/in (315/cm) NRZI data density at a std speed of 45 in (114 cm)/s. **Innovative Data Technology,** 4060 Morena Blvd, San Diego, CA 92117.

See at Booth 2642

Circle 538 on Inquiry Card

BIDIRECTIONAL PRINTER



Printing speed of 100 char/s and a noise level of <60 dB are features of the microprocessor controlled 4520 bidirectional printer. The unit has a 100% duty cycle, prints a 9 x 9 dot matrix, and accommodates paper roll or fanfold. Interface is either serial or industry std parallel. The 4542 printer provides full graphic capability and micro step control of the 9 x 9 matrix Stored-Force Flex Hammer Head. Proportioned spacing increases throughput to >250 char/s. **Facit, Inc,** 66 Field Point Rd, Greenwich, CT 06830.

See at Booth 2321

Circle 539 on Inquiry Card

VIDEO DISPLAYS

BHD-500 series of 5″ (13-cm) monochrome TV monitors, together with the 7″ (18-cm) -700, 9″ (23-cm) -900, and 12″ (30-cm) -1200 series, are designed for use in data display terminals. In the normal configuration, they can be mechanically and electrically fitted to standard data terminals without modification, accepting the industry standard 10-pin input connector (with custom connector configurations also available). Thick film hybrid circuitry is used. With current consumption of <1 A, the monitors operate at min temp levels and do not present excessive loading on a std 12-Vdc power source at 900 mA. Either TTL levels (H drive, V drive, and TTL video) or composite video (with the addition of 1 plug-in hybrid module) can be accepted. Specs include video response of 10 Hz to 22 MHz, ±3 dB; pulse rise time of 30 V rise in 20 ns; geometric distortion of <2%; horizontal blanking of 11 μs nom; vertical blanking of 900 μs nom; and std scan frequency of 15,750 (±500) Hz horizontal and 50 or 60 Hz vertical. Vertical and horizontal size and linearity, raster centering, vertical hold, horizontal hold, contrast, and brightness have internal controls; brightness and contrast controls are external. Available in assembled kit form without chassis mounting frame, the monitors are normally provided with EIA P4 faceplate phosphor, but can be supplied with P31 or P39 phosphors. **Bell & Howell-Fernseh Inc, Display Devices,** 4000 Birch St, Newport Beach, CA 92660.

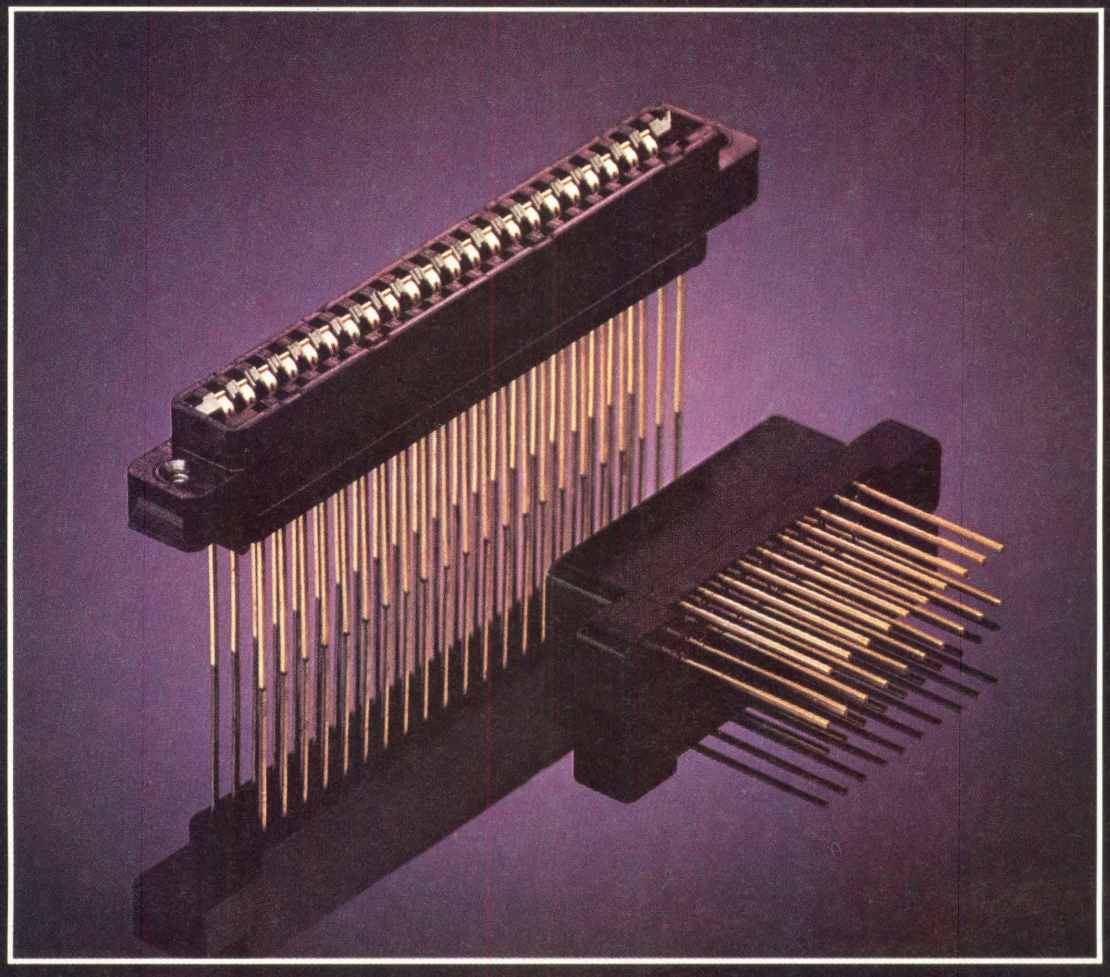
See at Booth 4439

Circle 540 on Inquiry Card

NOTE

1000 series booths are located in North Hall at the Anaheim Convention Center, 2000 series numbers are in South Hall, 3000 series in the Arena, and 4000 series in the West Hall. Booths 1 through 178 are part of the Personal Computing Festival and are located at the Disneyland Hotel Convention Center. Booths 201 to 999 are NCC exhibitors that are located in the Disneyland Hotel Lower Level Exhibit Hall.

Anybody can cut costs on a connector. The trick is to cut costs and leave the Viking quality in.



Our new low-cost P/C connector with a non-bifurcated beam contact is not quite as simple as it looks. The production is extremely sophisticated—including our exclusive AuTac gold plating that is specific, precise, reliable, and doesn't waste a speck of gold. See one and you'll see that while the cost is low, the quality is still, unquestionably, Viking quality.

Viking
CONNECTORS

21001 Nordhoff Street/Chatsworth, CA 91311, U.S.A.
(213) 341-4330/TWX 910-494-2094

CIRCLE 70 ON INQUIRY CARD

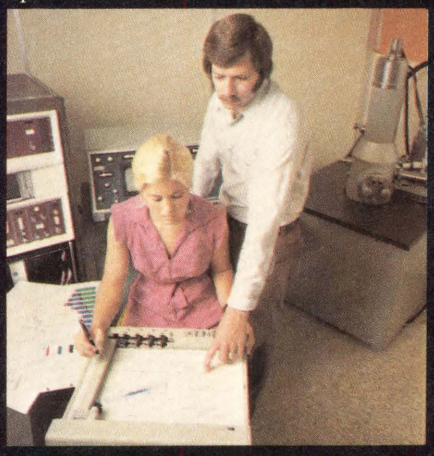


Common interface. Common-English programming. Uncommonly good graphics.

Now Hewlett-Packard brings easy-to-use color graphics to your RS-232-C system.

With the new Model 7220A plotter (left) it's simple to add HP's multicolor graphic capability to your system, any time. Our HP-GL programming language is based on common-English abbreviations with a large inventory of plotter commands. And our graphics, in four programmable colors, are uncommonly good. Good enough, in fact, to be publication quality.

The plotter is so versatile that it can be easily used in both OEM and end-user applications. HP includes important features to let you implement graphics on your system easily and quickly. Features like automatic pen selection, internal scaling, digitizing, internal character set selection and dashed lines. There's even an automatic paper advance model (7220S) that plots, cuts and stacks your graphics for unattended operation.



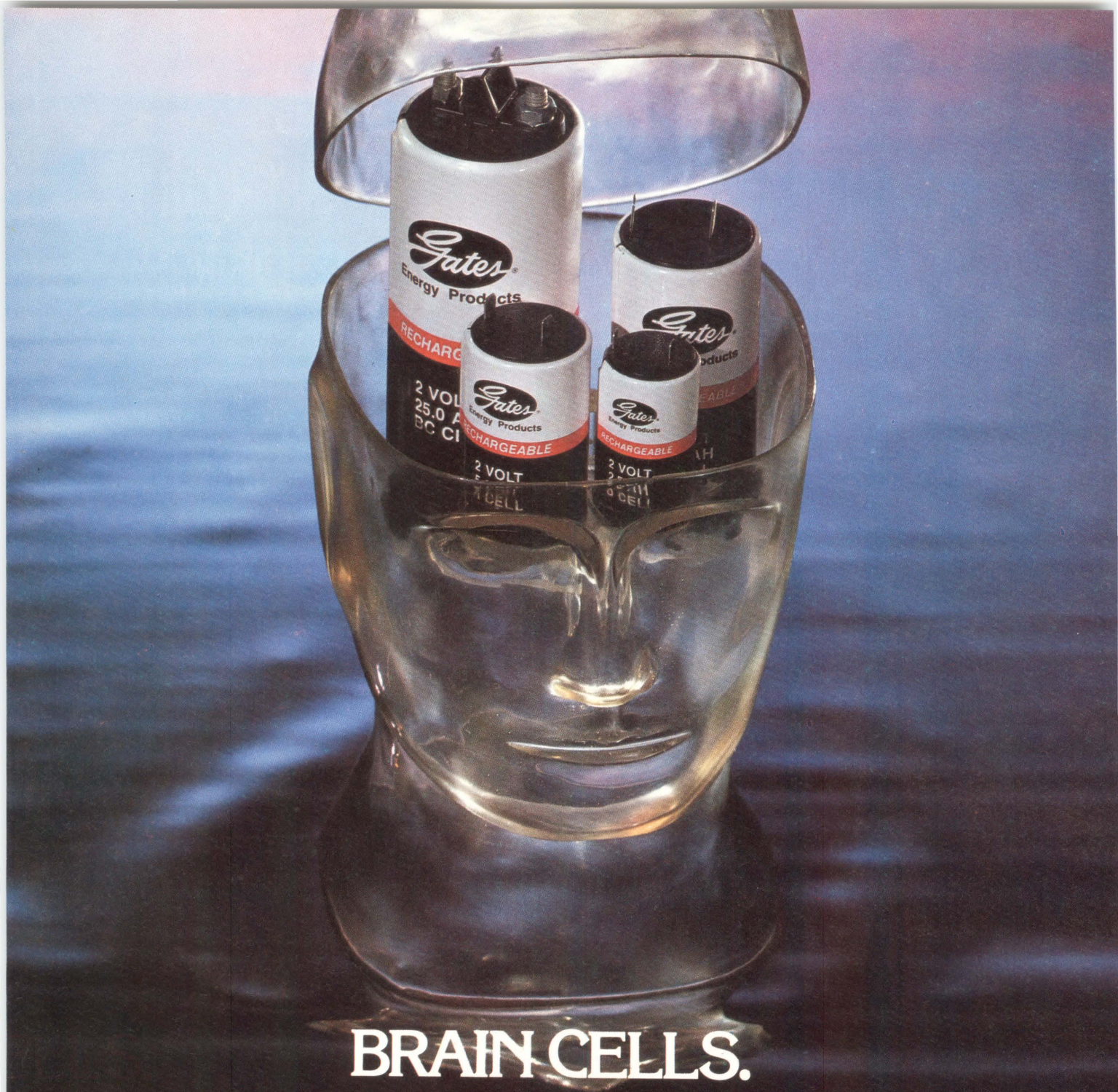
In addition to the A3 (11″ x 17″) 7220 Plotter, HP also offers the low cost Model 7225A, an A4 (8½″ x 11″) high quality plotter with RS-232-C hardwire connection and the 7240A which produces long axis plots and combines graphics and text printing on the same page. And they use the same plain talking HP-GL language. A plug-in module customizes the plotter to your computer, desktop computer or intelligent instrument system.

OEM discounts are available on all HP plotters. For complete information, contact your local Hewlett-Packard sales office or write to Hewlett-Packard, Attn: Greg Diehl, 16399 West Bernardo Drive, San Diego, CA 92127; (714) 487-4100. 11902



HEWLETT PACKARD

CIRCLE 71 ON INQUIRY CARD



BRAIN CELLS.

Employed by smart engineers for reliable, dependable, rechargeable power.

Now available in four, basic 2V cell sizes, ranging from 2.5 to 25Ah, for dozens of battery configurations and hundreds of applications.

With outstanding float and cyclical characteristics and superior storage life.

All invented, manufactured and refined by Gates Energy.

Be wise. Contact Gates Energy Products Inc., 1050 S. Broadway, P.O. Box 5887, Denver, CO 80217. Phone (303) 744-4806.

GATES ENERGY

CIRCLE 72 ON INQUIRY CARD

Circle our number on the reader service card for additional input.

NCC PRODUCT PREVIEW

PRINTER/PLOTTER SYSTEM



T-8200 impact dot matrix printer/plotter provides the full ASCII 96 u/lc char set at 300 lines/min. Choice of 10, 13, or 16 char/in (4, 5, or 6/cm) is optional at either 6 or 8 lines/in (2 or 3/cm), selectable by software control or an external manual switch. The system, based on the Printronix P300 printer/plotter plots with a dot density of 60 x 70 dots/in (24 x 28 dots/cm) at 33 in (84 cm)/min. Features include a static eliminator and self-test. **Trilog, Inc,** 17391 Murphy Ave, Irvine, CA 92714.

See at Booth 4250

Circle 541 on Inquiry Card

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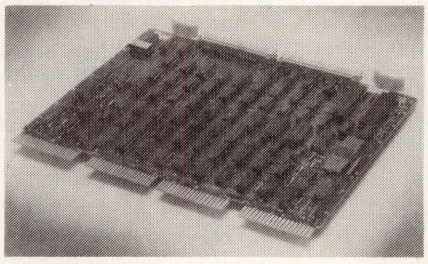
DOUBLE-SIDED FLOPPY DISC HEAD

Innovative double-sided floppy disc head will be available in 2 versions—1 for 48-track/in (19/cm) systems and the other for 100-track/in (40/cm) systems. The heads are also adaptable to 8 and 5.25″ (20- and 13.3-cm) double-sided drive systems. Also to be shown is a 16-channel positionable head for disc backup systems that records in a serpentine fashion. **Nortronics Co, Inc,** 8101 10th Ave N, Minneapolis, MN 55427.

See at Booth 1343

Circle 542 on Inquiry Card

QUAD-SIZE MAG TAPE COUPLER



Intelligent mag tape coupler model DU-130 requires a single PDP-11 SPC slot to interface up to 8 dual-density formatted mag tape drives, including streamers. Coupler has TM-11 emulation, RT-11/RSX-11/RSTS/IAS, and MUMPS software compatibility. It handles 9-track industry standard drives at speeds from 12.5 (31.75 cm) to 125 in (317.5 cm)/s and features FIFO buffer for DMA latency, automatic self test, and software or switch selectable density control. **Distributed Logic Corp,** 12800-G Garden Grove Blvd, Garden Grove, CA 92643.

See at Booth 3110

Circle 543 on Inquiry Card

CLUSTERED TERMINAL SYSTEM

4270 Series system includes 4274 system controller, 4278 display stations, and two models of printers. Series emulates IBM 3270 information display system and incorporates operating characteristics of both IBM 3274 control unit and IBM 3278 model 2 display station. Link to host computer supports IBM compatible data communications using either BSC or SDLC/SNA protocols. Speeds from 2000 to 9600 bits/s are supported. System is composed of multiple, task oriented microcomputers operating simultaneously but independently. Distribution of intelligence throughout each node assures flexibility, max throughput, and easy diagnosis and verification of hardware operating segments. Control functions are performed in system controller by 16-bit microprocessor; additional 8-bit processors are dedicated to I/O functions. Each controller can support any combination of up to 32 display stations and printers. Display stations present 1920 char (24 lines by 80 col) on 15″ (38-cm) antiglare screen. Additional 25th line displays full set of status information. Displays may be located up to 5000 ft (1524 m) from the controller and are connected with coaxial cable compatible with existing IBM coax. Keyboard resembles IBM 3278 and is functionally compatible, but has been redesigned to reduce shifting. Printers feature std microprocessor electronics, matrix printing, speeds of 160 char/s and 200 lines/min, and print full 132-char widths. **Racal-Milgo, Inc,** 8600 NW 41st St, Miami, FL 33166.

See at Booth 2418

Circle 544 on Inquiry Card

MICROCOMPUTER SOFTWARE SYSTEMS

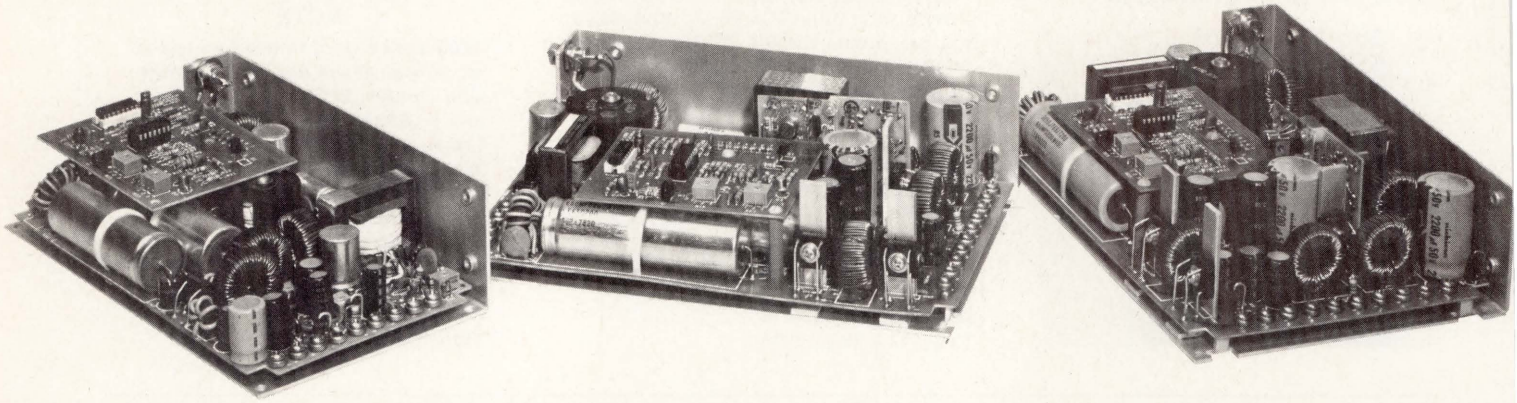
Z8000 BASIC is an exact implementation of the company's 5.0 version of BASIC-80 and BASIC-86. It is fully compatible with programs written in those languages, as well as with the ANSI standard for BASIC. Advanced features include full PRINT USING, error trapping, arrays with up to 255 dimensions, Boolean operators, and long variable names (up to 40 char). Disc versions support random and sequential files, file protection, and OPEN, CLOSE, GET, PUT, FILL, NAME, and MERGE statements. The software has a fast math package which computes each of the scientific functions (trigonometric, exponential, and random number generation) in approx 2 ms. Pascal-MS is a high level systems implementation language for 8- and 16-bit microprocessors. The language is ISO standard Pascal, plus a full set of system oriented extensions. The compiler includes a global optimizer and modular code generators for many microprocessors. **Microsoft,** 10800 NE 8th, Suite 819, Bellevue, WA 98004.

See at Booth 89

Circle 545 on Inquiry Card

MULTIPLE OUTPUT SWITCHING POWER SUPPLIES

THE SWITCHER COST BREAKTHROUGH YOU'VE BEEN WAITING FOR!



Power/Mate introduces Econo/Switch Multiple Output Switching Power Supplies priced to give substantial savings, yet provide the performance and reliability you depend on in a quality switcher.

The use of Power/Mate's new monolithic chip permits the reduction of parts count by 20% for a much higher MTBF, backed up with a two year warranty. Reliability has been greatly improved by use of computer-aided "worst-case analysis," individual testing of every IC and semi-conductor, and a comprehensive burn-in program.

These carefully packaged units have extremely high component density for maximum wattage per cubic inch. The standard unit has a 5V primary regulated output and two 12 or 15V regulated outputs, plus 5V and 24V semi-regulated outputs. Special units are manufactured to order with voltages specified from 5 to 28V for each of the three regulated outputs and 5 to 50V for the two semi-regulated outputs. Total continuous output power of the unit is 100, 200 or 300 watts. (See charts)

The Econo/Switch multiple output supply gives you exceptional versatility, combined with reliability, efficiency and compactness... at low cost.

Features.

- **Up to five outputs, three regulated and two semi-regulated.**
- **Choice of voltage and current on all outputs up to maximum wattage total.**
- **Voltage adjustable on all regulated outputs.**
- **Brownout protection.**
- **OVP standard on primary output.**
- **Overload protection.**
- **Short circuit protection.**
- **Reverse polarity protection.**
- **Soft start protection.**
- **Adjustable current limiting on regulated outputs.**
- **Meets UL and CSA standards.**
- **Convenient 2-surface mounting.**
- **Convection cooled.**
- **Remote sensing.**
- **Advanced EMI filtering.**
- **Isolated Returns.** (Note 3)

ESM-100 Series—100 Watts — $199.

	Model	Output 1	Output 2	Output 3	Output 4	Output 5	Max. Cont. Output Power
Standard Models	ESM-100-5001	5V@10A	12V@3A	12V@3A	5V@2A	24V@2A	100W
	ESM-100-5002	5V@10A	15V@3A	15V@3A	5V@2A	24V@2A	100W
Customized Models	ESM-100-xxxx	*@10A	*@3A	*@3A	*@2A	*@2A	100W

ESM-200 Series—200 Watts — $319.

	Model	Output 1	Output 2	Output 3	Output 4	Output 5	Max. Cont. Output Power
Standard Models	ESM-200-5001	5V@20A	12V@4A	12V@4A	5V@2A	24V@4A	200W
	ESM-200-5002	5V@20A	15V@4A	15V@4A	5V@2A	24V@4A	200W
Customized Models	ESM-200-xxxx	*@20A	*@4A	*@4A	*@2A	*@4A	200W

ESM-300 Series—300 Watts — $399.

	Model	Output 1	Output 2	Output 3	Output 4	Output 5	Max. Cont. Output Power
Standard Models	ESM-300-5001	5V@30A	12V@6A	12V@6A	5V@4A	24V@4A	300W
	ESM-300-5002	5V@30A	15V@6A	15V@6A	5V@4A	24V@4A	300W
Customized Models	ESM-300-xxxx	*@30A	*@6A	*@6A	*@4A	*@4A	300W

* User specified. Consult factory or local sales office. Minimum 250 units

Note 1: Maximum specified current cannot be drawn from all outputs simultaneously. At no time should the average current exceed the maximum continuous output power. Above this point, output voltages and currents will be automatically reduced on all outputs. **Note 2:** Output 1 must be loaded to 15% of total output power to maintain proper regulation of other outputs. (Supply will not be damaged by no-load condition on Output 1) **Note 3:** On ESM-200 and ESM-300 models, all five outputs are isolated. On ESM-100 models outputs 4 and 5 have a common return. All other outputs are isolated.

Options: Crowbar up to 8 Amps $8, greater than 8 Amps $16. Add Suffix V to Model No. Cover $10. Add Suffix C to Model No.

Specifications.

AC Input. 95-132 and 190-264 VAC, 47-63Hz.

Regulation. Line—0.2% within AC limits specified above. Load regulation first three outputs ±0.2%. Load regulation last two outputs ±5%, cross regulation ±3%.

Noise and Ripple. 50mV p-p on first output, 150mV on all other outputs.

Temperature Coefficient. 0.02% per °C on first output, 0.05% per °C on all other outputs.

Efficiency. 65 to 80% typical.

Transient Response. Recovery to 1% in 2 milliseconds for a 50 to 100% load change.

Remote or Local Sensing. Provision included for improved overall regulation.

Overload and Short Circuit Protection. Solid state short circuit protection. Automatic electronic current limiting circuit limits output current to a preset value, thereby providing protection for the load as well as the supply. Units cannot be damaged by prolonged short circuits.

Overshoot. No voltage spikes on turn-on, turn-off or power failure.

Overvoltage Protection. Built in on primary output.

Energy Storage Time. The output voltage will remain within regulation for a minimum of 16 milliseconds after loss of AC input power (from nominal line voltage).

Polarity. May be either positive, negative or floating up to 300 volts DC.

Soft Start. Provides input current limiting at turn-on.

Long Term Stability. 0.1% for 8 hours after 20 minute warm-up.

Ambient Operating Temperature. Continuous duty from 0°C to 71°C. Full rating from 0°C to 50°C, derate linearly to 50% of rating at 71°C.

Storage Temperature. −55°C to +85°C.

Quality Control. In accordance with MIL-I-45208.

POWER/MATE. THE SWITCHER COMPANY.

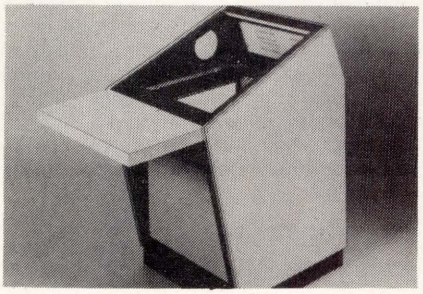
514 S. River St./Hackensack, New Jersey 07601/(201) 440-3100/TWX (710) 990-5023
3303 Harbor Blvd./Costa Mesa, CA 92626/(714) 957-1606/TWX (910) 595-1766

The world's largest supplier of quality switching power supplies.

CIRCLE 73 ON INQUIRY CARD

NCC PRODUCT PREVIEW

STYLED MODULAR CABINETS AND CONSOLES



Combining vertical bays and sloped-front consoles with options including pull-out writing surfaces, multibay configurations, anti-tip legs, frame levelers, and trim gives almost unlimited possibilities for equipment enclosures. Consoles protect contents in use or in transit. Std frames, with a load of 1200 lb (540 kg) have passed Air Force 16G sand drop test and vibration from 1 through 15 cycles, 20-s duration on each cycle, without cracks or fractures. **Amco Engineering Co,** 3801 N Rose St, Schiller Park, IL 60176.

See at Booth 3106
Circle 546 on Inquiry Card

MINICOMPUTER DISC MASS STORAGE SYSTEMS

Drives with 600M + byte capacity allow Computroller V disc systems to handle up to 5.2G bytes of data at transfer rates to 1209k bytes/s. Drives will be available in fixed (Winchester) and removable media models for DEC PDP-11, PDP-11/70, and Interdata 32-bit minicomputers. Addition of the 600M + byte disc system increases inherent flexibility of Computroller V and more than doubles previous storage capacity. **Diva, Inc,** 607 Industrial Way W, Eatontown, NJ 07724.
See at Booth 4313
Circle 547 on Inquiry Card

SELF-PROMPTING PORTABLE COMPUTER

Miniterm^{R} model 1206/PAT intelligent portable terminal uses preprogrammed application modules that can be tailored to the user's environment and programmed to interactively prompt the user, facilitating operation by persons with no previous EDP training. Modules consist of BASIC source programs that are automatically called and loaded via minicassette and other optional storage media. Modules can be quickly changed and updated. Step by step procedure that automatically executes a program and error-checks each entry guides the user. Terminal has a 64k processor with 32k RAM work space available for execution of application programs. Programs can be developed in the company's 1206 user-programmable portable computer and are written either in BASIC or Motorola 6800 assembly language. Standard features include 80-col, 50-char/s thermal printer, integral minicassette drive, built-in modem, and acoustic coupler. Entire unit weighs 17 lb (7.65 kg). **Computer Devices, Inc,** 25 North Ave, Burlington, MA 01803.



See at Booth 1447
Circle 548 on Inquiry Card

CARD BASED ACCESS AND MANAGEMENT CONTROL SYSTEM



Identification Network System offers security with patented Ruscard, which is identical to std plastic credit card, but has a unique identification number encoded. More than 1T (10^{12}) code combinations eliminate possibility that code or set of codes can be deciphered. MAC 530 handles from 4 to 32 reader/terminals, 16 to 64 cardholder status levels, and 16 to 127 time intervals; MAC 540 handles 20,000 identification numbers, and supports 256 terminals, and 256 status levels. **Rusco Electronic Systems,** 1840 Victory Blvd, Glendale, CA 91201.
See at Booth 3009
Circle 549 on Inquiry Card

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SMALL BUSINESS SYSTEM SOFTWARE PACKAGES

Designed for the Chieftain small business computer system, Payroll Processing, Inventory Control/Order Entry, and Accounts Receivable/Invoice Entry packages run under Random DOS on a 48k-byte, 6800 microprocessor with a min of 360k bytes of disc storage. Common features include direct online updating and inquiry of selected items and instantaneous status reporting of data. Reports can be sorted in several formats and limited to high and low ranges within categories. Password protection maintains confidentiality of payroll data and automatic handling of vacation and sick hours. For inventory control, recording sales automatically reduces inventory on hand. Back orders can be created and generated and a bill of materials function allows for automatic updating when items are sold. Invoice processing is designed as the frontend processor for accounts receivable system. **Smoke Signal Broadcasting,** 31336 Via Colinas, Westlake Village, CA 91361.
See at Booth 18
Circle 550 on Inquiry Card

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MODEM FOR SMALL BUSINESS SYSTEMS

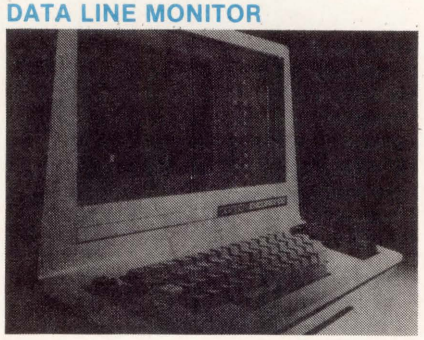


A Bell compatible modem enables computers and/or interactive terminals to communicate with each other via the analog facilities of the public telephone network. Model 103 LP allows full duplex data communication over 2-wire telephone circuit at speeds to 300 bits/s. The modem is independent from the ordinary ac electrical system. Three snap-in connections transform a normal telephone into a data set. The unit contains connectors for both RS-232 and current loop interfaces. **Universal Data Systems,** 5000 Bradford Dr, Huntsville, AL 35805.

See at Booth 1700

Circle 551 on Inquiry Card

DATA LINE MONITOR



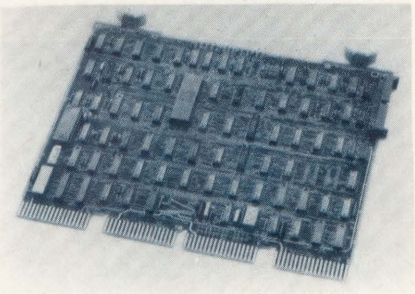
Data Monitor-200 is a portable passive device with intelligent diagnostic features including data traps and selective searches. It comprises an integral 5″ (12.7-cm) CRT, control keypad, realtime interface LEDs, 2k capture buffer, and optional but integral data tape recorder. 15 operational speeds range from 50 to 9600 bits/s. 256-char CRT display is in 16-char x 16-line format. Line codes are ASCII and EBCDIC, with automatic code level selection. Unit dimensions are 14 x 12 x 6″ (35.6 x 30.5 x 15.2 cm), and weight is 35 lb (15.75 kg). The monitor has been designed to diagnose a majority of data network hardware and software problems, and can be set up for test in seconds. Upon power-up a self-test procedure is executed, followed by a CRT menu of selected test modes. Flexibility is enhanced by compatibility between data tape recorders. Data can be recorded on one unit and analyzed by another without error. **Digitech Data Industries, Inc,** 66 Grove St, Ridgefield, CT 06877.

See at Booth 4431

Circle 552 on Inquiry Card

SYNCHRONOUS COMMUNICATIONS INTERFACES

Extending performance of LSI-11/23, LSI-11, and PDP-11 computers, DUP-11 compatible interface for Q-bus CPUs makes protocol handling, error checking, and other capabilities available to low cost system users; DUP-11 compatible interface for Unibus computers offers performance upgrade over existing products. Both synchronous single-line interfaces are functionally equivalent and software compatible with the DEC DUP-11, providing parallel to serial and serial to parallel data conversion, EIA level conversion, modem control for full- and half-duplex operation, protocol management, and bus interface. They also provide flexibility in handling of bit and byte oriented protocols. With data rates to 500k bits/s, the devices accommodate Bisync and DDCMP in BCP and SDLC, ADCCP, and HDLC bit oriented protocols. Programmable char lengths of 1 to 8 bits for BOP and 5 to 8 bits for BCP, tailor boards to variety of applications. Interfaces are contained on single quad boards; for Q-bus all signal handling is confined to A and B slots for integration flexibility. **MDB Systems, Inc,** 1995 N Batavia St, Orange, CA 92665.



See at Booth 2117

Circle 553 on Inquiry Card

HIGH PRECISION ATTACHED PROCESSOR

Max computational throughput of the FPS-164 attached processor is 12M floating point operations/s. The precision exceeds 15 decimal digits through 64-bit floating-point arithmetic. Architecture features internally synchronous operation through 7 independent parallel data paths, separate memories, and pipelined arithmetic units. Interface to a host I/O or DMA channel is via a hardware and software interface. **Floating Point Systems, Inc,** PO Box 23489, Portland, OR 97223.

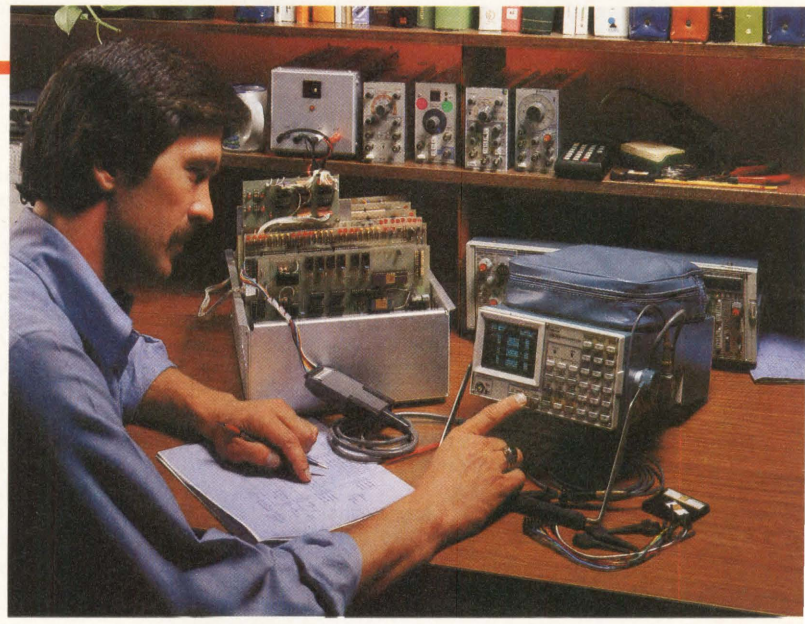
See at Booth 2452

Circle 554 on Inquiry Card

308 DATA ANALYZER

Big power in a small package.

The 308 operates in four modes: parallel state, parallel timing, serial state and signature analysis.



The 308 Data Analyzer. From Tektronix.

The new 308 Data Analyzer packs an impressive array of logic analysis capabilities inside its trim, 8 pound (3.6 kg) frame. For instance, it operates in the serial and signature modes as well as parallel state and timing. And samples both synchronously and asynchronously up to 20 MHz. With a variable voltage threshold that covers all logic families in addition to TTL.

Two separate memories, acquisition and reference, allow automatic data comparisons. If there's no data difference, the sampling process is repeated until a discrepancy appears. And the acquisition memory can be automatically searched for any given word.

Word recognition can be up to 25 bits and includes an external output to trigger other instruments. And the trigger itself can be delayed up to 65,535 clock pulses past the trigger point. The 308 features a latch mode (5 ns), a memory "window" to let you closely examine portions of the memory and state tables which are displayed in binary, hex and octal.

The 308 Data Analyzer, from Tektronix. Performance? Uniquely versatile. Size? Conveniently compact. Price? Exceptionally reasonable.

If you're interested, contact your local Tektronix field office, or write us at:

U.S.A.
Tektronix, Inc.
P.O. Box 1700
Beaverton, OR 97075
Phone: 503/644-0161
Telex: 910-467-8708
Cable: TEKTRONIX

Africa, Europe Middle East
Tektronix Int'l, Inc.
European Marketing Center
Postbox 827
1180 AV Amstelveen
The Netherlands
Telex: 18312

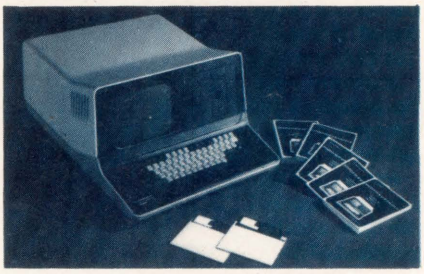
Asia, Australia, Canada, Central & South America, Japan
Tektronix, Inc.
America's/Pacific
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Beaverton, OR 97077
Telex: 910-467-8708
Cable: TEKTRONIX

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For immediate action dial our toll-free automatic answering service 1-800-547-1512

MICROCOMPUTER DEVELOPMENT SYSTEM



EXORset 30 eases the burden of software costs by providing a productive means of generating software. Resident editor/assembler and high level extended BASIC interpreter/compiler are std. Coupled with 160k bytes of mini-floppy disc storage, software provides ability for program generation. Using the 8-bit MC6809 microprocessor and the extended BASIC package, relocatable object code is generated; when placed in a read-only device and used with ROMable runtime package, code can be executed in its application. The development system has a full size ASCII keyboard, 16 user-assigned function keys, and a high resolution 9″ (22-cm) CRT capable of displaying 22 lines of 80 or 16 lines of 40 char and a full 320 x 256 dot graphic image simultaneously. Memory consists of 48k bytes of RAM, expandable to 56k using standard memory boards, and 12 EPROM/ROM sockets that accept up to 24k bytes of user firmware. EXORbug monitor controls keyboard and display operations and offers complete debugging facilities. Dual mini-floppy disc drives provide 160k bytes of mass storage. XDOS operating system takes care of all operations and file management. **Motorola Semiconductor,** 2222 W Broadway, Mesa, AZ 85201.

See at Booth 2230

Circle 555 on Inquiry Card

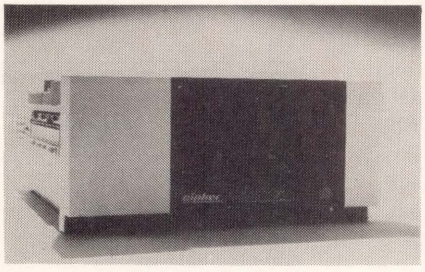
PRECISION REEL TO REEL CASSETTE TAPE TRANSPORT

Transport features microprocessor based digital control system that continuously monitors and regulates tape speed, tension, and assures uniform start/stop profiles. Model 6440 is designed with all major structural components molded of reinforced plastic materials to assure extreme stability and strength. When inserted into unit, cassette is constrained within a precision head guide assembly mounted in the door. When door is closed, cassette engages reel motor hubs and cassette positioning guides. Sensing is provided for end of tape, load point, early warning, cassette in place, side A1B, and write protect. Constant tape speed and tension are controlled by system incorporating optical sensors located on each motor shaft to provide velocity information. Microprocessor monitors velocities, performs necessary calculations, and controls voltage applied to takeup motor to provide uniform tape velocity over length of tape. Similarly, tape tension and start-stop profiles are adjusted depending on tape position and relative hub diameters. This assures constant tape tension over length of tape and uniform start-stop profiles at any point of tape travel. Unit transfers data at 30 in (76 cm)/s. It has a 60″ (152-cm)/s search speed. In addition, slew speed of 120″ (304 cm)/s is provided. Packing density on tape is 800 or 1600 bits/in (314 or 629/cm). Transport can be provided with just tape motion controls and basic read/write electronics. An RS-232-C interface or IEEE 488 bus compatible interface are available. **Raymond Engineering, Inc,** 217 Smith St, Middleton, CT 06457.

See at Booth 1201

Circle 556 on Inquiry Card

STREAMING TAPE DRIVE



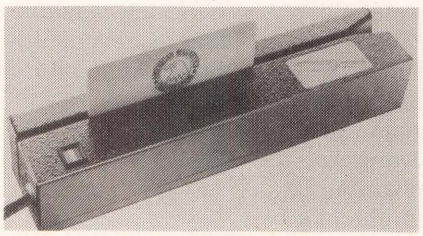
F880X Microstreamer™ allows use of a streaming mode to load or unload large blocks of data on the fly at 100 in (254 cm)/s, or use of the 25-in (63.5-cm)/s operating mode to interactively read or record data in conventional applications. The drive reads and writes data in 1600-bits/in (630/cm), phase encoded, ANSI-compatible format. Storage capacity averages 37M bytes of formatted, or up to 46M bytes unformatted data, depending on block length. Many disc files can be dumped in a single continuous operation in less than 5 min. Up to 8 drives can be daisy chained on the company's formatter interface for additional capacity. The device can handle 7″ (17.8-cm), 8.5″ (21.6-cm), or 10.5″ (26.7-cm) dia reels of 0.5″ (1.27-cm) tape. The microprocessor controlled drive contains formatting electronics as well as a complete set of service aids and diagnostics. **Cipher Data Products, Inc,** 5630 Kerny Mesa Rd, San Diego, CA 92111.

See at Booth 1729

Circle 557 on Inquiry Card

MAGNETIC CARD ENCODER/READER

Model 44 adds a write capability that allows it to encode, as well as read, magnetic stripe cards, badges, and passbooks. Dual heads are independently suspended on parallelogram springs in a gimbal mount. Low contact force



guarantees min head and card wear. Read and write assemblies offer increased reliability when reading warped and contaminated cards. **American Magnetics Corp,** 2424 Carson St, Torrance, CA 90501.

See at Booth 1101

Circle 558 on Inquiry Card



ok

EW-8 Wire Wrapping Tool

EW-8 $85.11*
EW-8-BF $92.90*
VIT-1 $15.00*

NEW ELECTRIC WIRE WRAPPING TOOL

O.K. Machine and Tool Corp. has introduced its new model EW-8 electric wire-wrapping tool. The tool is interchangeable with its previous model EW-7D, and incorporates a number of improvements at no increase in price. Rated to accept bits for wire sizes 22-30 AWG, model EW-8 features a reinforced Lexan™ housing, RFI reducing circuitry, and a high reliability motor and indexing mechanism. The tool is double insulated and weights only 14 ounces. Available with optional anti-overwrapping device as model EW-8-BF. Also available with accessory tool VIT-1 which permits easy resetting of indexing position in 45 degree increments.

Available ex-stock from

™ General Electric

OK Machine & Tool Corporation
3455 Conner St., Bronx, N.Y. 10475 U.S.A.
Tel. (212) 994-6600 Telex 125091

*Minimum billings $25.00, add shipping charge $2.00
New York State residents add applicable tax



Inventory reports



Point-of-sale



Data entry



Environmental control



Financial reports



Computer graphics

Sylvania breaks the color barrier.

Introducing America's first 19-inch color data display tube.

Not just a tube with color.

A tube with gorgeous, glorious, sharp Sylvania color.

Color that provides clearer images and better contrast than anything available anywhere.

Color that makes small characters a breeze to read, with less fatigue.

Crystal clear color created by a high density tri-dot mask.

Color sharpened by a multiple-beam electron gun and enhanced by a Chromatrix dark surround negative guard band, and a rare earth phosphor system.

Sylvania color.

It's completely changed the picture in data display tubes.

Write Product Marketing Manager for our latest catalog:

GTE Sylvania
Data Display Tube Division
700 North Pratt Street
Ottawa, Ohio 45875



SYLVANIA | GTE

CIRCLE 75 ON INQUIRY CARD

IBM 3270 COMPATIBLE CRT DISPLAY SYSTEM

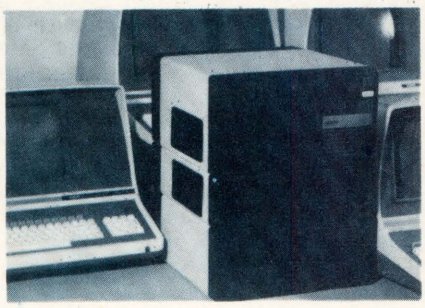


Featuring the patented Charactron^{R} CRT for generation of high resolution fully formed characters, the 132-70 system includes the 132-78 display station, 132-80 printer, and 132-74 cluster controller. Standalone arrangement is compatible with 3275 and 3276 display stations and may also be field adapted to a clustered environment with the 132-74 controller. Display formats, ranging from 40 char x 12 lines to 132 char x 27 lines, are switch selectable. Screen size is 11 x 8″ (27.9 x 20.3 cm), with resolution equivalent to more than 4k TV raster lines. Detachable keyboard has a 5-ft (1.5-m) cable connection and a 104-key typewriter layout, including 12 function keys and separate 11-key numeric pad. Communication is binary synchronous, half or full duplex, at 1200, 2400, 4800, or 9600 bits/s, through a modem and RS-232-C interface. SDLC option will be offered in the future. In cluster configuration up to 32 display terminals and/or 132-80 printers may be connected in any combination. Terminal to controller connection is by coaxial cable up to 5000 ft (1524 m) long. **DatagraphiX, Inc,** PO Box 82449, San Diego, CA 92138.

See at Booth 4201

Circle 559 on Inquiry Card

MODULAR DESKTOP COMPUTERS



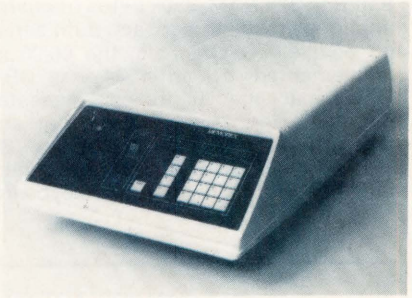
Multivision systems of 3 vertically stackable components offer efficient data storage on a Winchester disc and a multi-user operating system for simultaneous use of 4 display terminals. Basic system 1 contains the 64k-byte, 5-MHz microcomputer with all I/O and controller circuitry to operate the dual mini-floppy disc drives and a std display terminal. Multivision 2 adds an 8″ (20-cm) Winchester technology disc with 5M or 10M bytes of storage; model 3 supports a total of 4 display terminals with up to 256k bytes of RAM and 3 more terminal ports. A printer and display may also be added. A CP/M compatible, multi-user operating system supports the Microsoft BASIC interpreter and compiler, a proprietary word processing package, 5 business application packages and 2 levels of ISAM capability—single-key and multi-key, multi-record versions. The computer performs std small business accounting procedures and functions as a word processor. **Applied Digital Data Systems, Inc,** 100 Marcus Blvd, Hauppauge, NY 11787.

See at Booth 1562

Circle 560 on Inquiry Card

REMOTE CLUSTER CONTROLLER

Functionally equivalent to controller portion of the IBM 3276 control unit display station, models 1, 2, 3, and 4, the 2076 controller will attach up to 8 devices, which may be display stations, printers, or a mix of display stations and printers. It is compatible with IBM System/360, System/370, 303X, and 43XX. Model 4 communicates to a communications controller through external modems having internal clocking over a full- or half-duplex communication facility using BSC data link protocol at speeds to 9600 bits/s. Diagnostic capabilities built into the system include power-on which runs automatically when power is turned on. Offline diagnostic provides variety of information on devices connected to unit and the controller line communications. An online diagnostic program provides information about the device adapters, coaxial cables, and attached devices. With the addition of device adapters, the system supports up to 8 Category A display stations or display stations and printers. **Memorex Corp, Communications Group,** 18922 Forge Dr, Cupertino, CA 95014.



See at Booth 2363

Circle 561 on Inquiry Card

DOUBLE-SIDED, DOUBLE-DENSITY FLEXIBLE DISC DRIVES

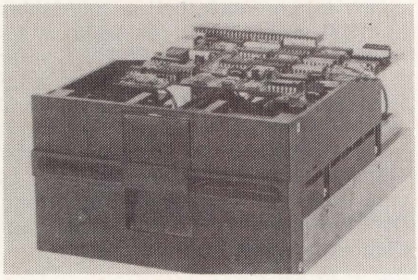
Packaged in a housing little larger than the diskette itself, drive approaches theoretical minimum size, and achieves tight tolerances. Modularity simplifies maintenance. Heads are IBM compatible, including tunnel erase; when unloaded both heads move away from the diskette surface, eliminating head or media wear. A half-step positioning motor reduces error tolerances by taking 154 steps/side. Power consumption is 30 W, and drive efficiency is rated at 60 to 80%. **MFE Corp,** Keewaydin Dr, Salem, NH 03079.

See at Booth 2231

Circle 562 on Inquiry Card

NCC PRODUCT PREVIEW

DOUBLE-TRACK DENSITY MINI-FLOPPY DISC DRIVES



Doubling the track density of other units, single- and double-sided drives read/write 96 tracks/in (37/cm). When double-density and double-sided read/write features are combined, unit can store 1M byte on a 5.25″ (13-cm) floppy disc. Model 91 reads/writes approx 480k bytes of data on a single side of a 5.25″ disc; model 92 provides capacity for 960k bytes on both sides. Both give track to track access time of 5 ms. A proprietary split-band head position device, direct driven by a stepper motor, provides fast, precise, and reliable positioning for read/write head. Head assembly for double-sided unit incorporates fixed bottom head with gimbaled top head. This assembly, in conjunction with precision chassis design, provides 3M in-contact passes of the media over a single track. Performance and reliability are assured by an automatic disc positioning and ejector mechanism that prepositions the disc over the spindle hub before the clutch centering device is engaged, to facilitate precise alignment. The mechanism also partially ejects the disc when the door is opened, making its removal quick and easy. Units accommodate FM, MFM, and M²FM encoding. **Micro Peripherals, Inc,** 9754 Deering Ave, Chatsworth, CA 91311.

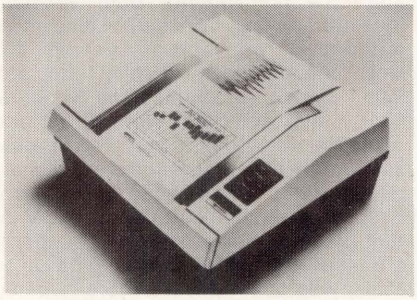
See at Booth 4423

Circle 563 on Inquiry Card

NOTE

1000 series booths are located in North Hall at the Anaheim Convention Center, 2000 series numbers are in South Hall, 3000 series in the Arena, and 4000 series in the West Hall. Booths 1 through 178 are part of the Personal Computing Festival and are located at the Disneyland Hotel Convention Center. Booths 201 to 999 are NCC exhibitors that are located in the Disneyland Hotel Lower Level Exhibit Hall.

DESKTOP ELECTROSTATIC PRINTER/PLOTTER



V-80 prints 1000 132-col lines/min and plots an 11 x 8.5″ (28 x 22-cm) plot with 200-dot/in (79/cm) resolution in 7 s. With optional controller, it can produce a hardcopy from CRT or video source in 20 s or less. Package can be placed on a desktop, optional stand, or recessed in a computer system console. It weighs 75 lb (34 kg). A single cover opens to allow access to paper and toner. Versaplot™ software consists of FORTRAN callable subroutines. **Versatec, a Xerox Co,** 2805 Bowers Ave, Santa Clara, CA 95051.

See at Booth 1463

Circle 564 on Inquiry Card

MICROCOMPUTER SYSTEM

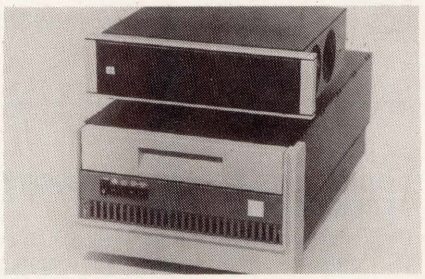
Featuring 32k RAM, 280k bytes of online mini-floppy disc storage, and both serial and parallel I/O channels, the 80-20 is complemented by an 1024-char CRT display, packaged in its own pedestal mounting. Hardware features that are standard on the system include Z80 CPU, two double-density, single-sided mini-floppy disc drives, ASCII keyboard with 13-key alphanumeric pad and row of special function keys, and 110- to 9600-baud serial communications interface. Optional are an additional 32k of RAM (to 64k total) and double-density, double-sided mini-floppy disc drives. Standard software for the system includes monitor, editor, and utilities, BAL operating system; BAL language; file management system including sequential, indexed sequential, and random access; and assembly language. Optional are CP/M operating system, including context editor, assembler, and debugger; MBASIC (both interactive and compiler), CBASIC compiler, COBOL, Pascal, and APL. **R2E of America,**47 Bedford St, SE, Minneapolis, MN 55414.

See at Booth 160

Circle 565 on Inquiry Card

CUSTOM MICROCOMPUTER SYSTEMS

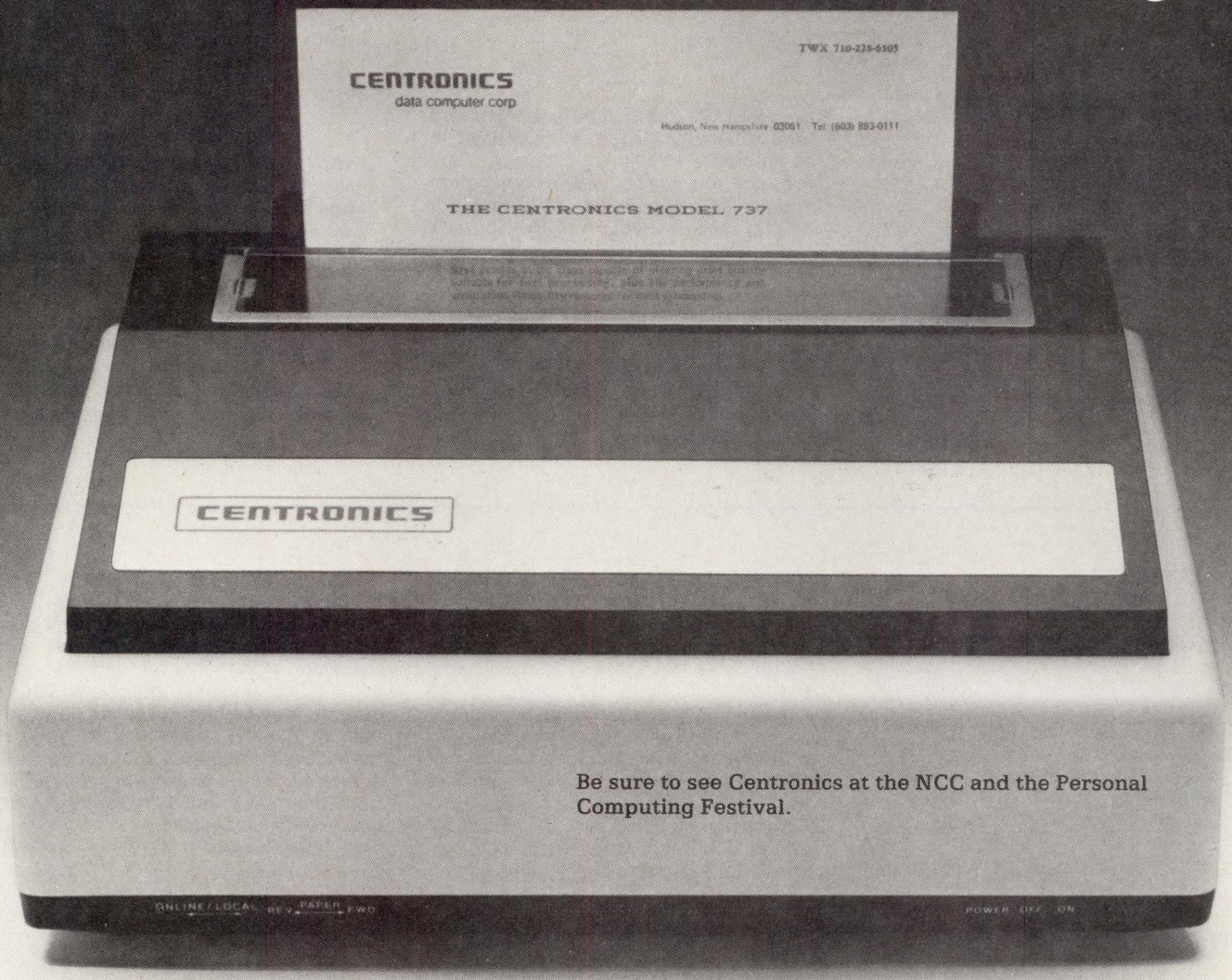
Super Pegasus configuration of the Pegasus cartridge disc incorporates a 90M-byte storage module comprised of a 75M-byte fixed disc and 15M-byte removable disc. Super Gemini and Super Tristar floppy disc systems combine an 8″ (20-cm) 8M-byte Winchester drive with 1 or 2 1.25M-byte floppy disc drives. Super Tristar has an additional option for 2 8M-byte, 8″ (20-cm) Winchester drives combined with a 1.25M-byte floppy disc drive. Systems normally include an LSI-11/2 CPU, 64k bytes of RAM, hardware bootstrap, line frequency clock, and a serial RS-232 I/O port. Options include an LSI-11/23 CPU, 256k bytes of RAM, and a QLV-11 quad serial I/O port. RT², RSX-11/S, RT-11, or RSX-11/M software licenses are offered. Language options include BASIC, BASIC-PLUS-2, FORTRAN IV, FORTRAN IV-PLUS, and other DEC software for RT-11 and RSX-11/M. **General Robotics Corp,** 57 N Main St, Hartford, WI 53027.



See at Booth 2163

Circle 566 on Inquiry Card

CENTRONICS MODEL 737: The Advantage for Low Cost Word and Data Processing



Be sure to see Centronics at the NCC and the Personal Computing Festival.

The flexibility and print quality OEMs need is here now. The new Model 737 is the small business printer versatile and reliable enough to meet almost any systems requirement. It's the first low-cost printer to offer print quality suitable for text processing plus the performance and applications flexibility required for data processing and electronic mail. And this latest Centronics breakthrough is priced under $1000 in the U.S.A.

Outstanding Print Quality

Model 737 is the first small business printer to offer correspondence quality printing. 18 x 9 dot matrix provides high-quality characters with true descenders as well as underlining. Proportional spacing, the ability to justify right margins and serif typeface makes the 737 ideal for text processing applications. Standard business data processing spacing of 10 and 16.7 characters per inch are also resident in the 737, allowing for applications ranging from letters to aged accounts receivable reports. The steel platen assures crisp, clean print impression.

Unexpected Features

Leave it to Centronics to have some surprises in the new Model 737. You get the ability to print subscripts and superscripts. Especially attractive to OEMs requiring superior print appearance and/or chemical or mathematical applications. Centronics gives you its field proven 700 Series printhead, stepper motor paper drive, fewer moving parts, microprocessor electronics and high volume production to achieve reliability that you wouldn't expect in a compact, low-cost printer.

The 737 is quiet. An optional acoustic cover makes it ideal for office environments.

Pick Your Paper

Run letterhead paper for correspondence, roll paper for general information, or fan-fold paper for standard data processing (payroll, billing, inventory, etc.). You can, with the 3-way paper handling ability of the Model 737.

The Printer of the Future... Today

Never before has one printer offered such high quality, reliability, and applications flexibility at such low cost.

Another workhorse in the Centronics 700 Series is the 730, if you don't need the correspondence quality of the 737. Delivers 100 c.p.s. at even greater savings.

Why Wait?

The new Model 737 is now available for delivery. Call Ance Thatcher, (603) 883-0111. Centronics Data Computer Corporation, Hudson, New Hampshire 03051, or any of our 15 U.S.A. or 9 international sales offices.

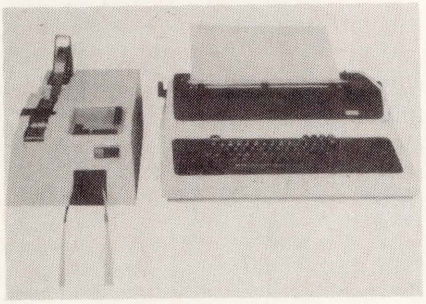
All Centronics products are supported by the largest worldwide service network of any independent printer company.

CENTRONICS® PRINTERS
...the advantage

CIRCLE 76 ON INQUIRY CARD

NCC PRODUCT PREVIEW

AUTOMATIC SEND/RECEIVE TAPE SYSTEM



Standard RS-232-C interfaced (current loop optional) ASR-334 can operate at 10 to 30 char/s at push of a button. Tape feed controls can be used in conjunction with offline generation of a tape for editing and correction prior to data transmission. Unit uses heavy duty Mylar rated punch mechanism plus matrix printhead. The two main components of the system are of all modular construction and can be purchased separately. **Data Specialties, Inc,** 3455 Commercial Ave, Northbrook, IL 60062.

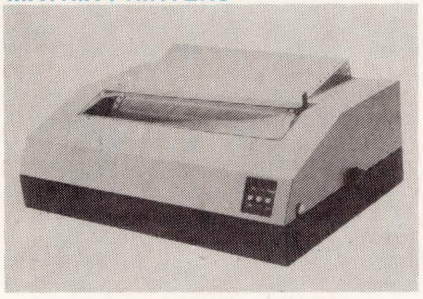
See at Booth 1460

Circle 567 on Inquiry Card

NOTE

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80- AND 136-COL MATRIX PRINTERS



Comet is an 80-col printer with 4 char sizes and switch selectable single- or bidirectional printing. The printer can handle forms from 4.5 to 10″ (11.4- to 25-cm) wide. Print speed is 125 char/s. Bidirectional mode throughput is 63 lines/min. Char sizes include normal width of 10 char/in (4/cm), double-width of 5 char/in (2/cm), compressed font of 16.5 char/in (42/cm), and compressed font double-width of 8.25 char/in (3/cm). Companion model Comet II is a 136-col printer with 2 char sizes. It prints bidirectionally at 125 char/s and 40 lines/min on forms up to 15.5″ (40 cm) wide. Char spacing is either 10 char/in (4/cm) or 5 char/in (2/cm) double-width. Both models offer English, German, Japanese, and Swedish alphabets for international communication. Microprocessor based devices have self-test capability and are equipped with programmable vertical format unit, a 136-byte data buffer, plus status signals to the driving device. **C. Itoh Electronics, Inc,** 5301 Beethoven St, Los Angeles, CA 90066.

See at Booth 4207

Circle 568 on Inquiry Card

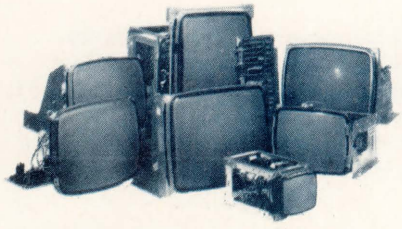
DUAL PROCESSOR INTELLIGENT TERMINAL SYSTEM

Delta 700 system incorporates two 16-bit 9900 processors linked by DMA interface to support two single or double floppy disc drives, 28-line x 80-char display terminal, P/ROM encoded keyboard, and interfaces for printers and host communications. System processing unit (SPU) controls user interfaces such as keyboard, display, and printer, directing entire system operation through a multitasking system executive. Auxiliary processing unit (APU) handles disc functions and runs BASIC. APU is generally transparent to the user and operates through its own memory. System comprises microprogrammable CRT/keyboard display terminal, 60-char/s impact printer, and double-sided disc drives. CRT screen can be segmented for multitasking operations. Hierarchical software modules available for diverse applications include BASIC, terminal control program (TCP), ISAM, and communication handler for interface to host. Integral diagnostics are included. **Delta Data Systems Corp,** Woodhaven Industrial Pk, Cornwells Heights, PA 19020.

See at Booth 1308

Circle 569 on Inquiry Card

5 and 9″ CRT DISPLAY MODULES



Compact M1000/M2000 series display modules have video response to 12 MHz, excellent geometry, and small CRT spot size, which combine to deliver 650-line horizontal resolution for sharp picture detail. Range of specs meets diverse requirements: chassis or kit; economy or high performance; separate sync, composite, or direct drive inputs; choice of phosphors; choice of scan frequencies; and with or without antireflective faceplate. MD4000 series 15″ (38 cm) units provide StepScan™, 22-MHz bandwidth, and customer adjustable dynamic focus. M4408, a 15″ full page raster scan module, is designed for high character density and/or graphics capability requirements. More than 6000 char can be displayed in either vertical or horizontal format. Offered for use with the M4408 is the LM1 character generator/display driver which is compatible with any currently available MPU or CPU. **Motorola Inc, Display Systems,** 1155 Harvester Rd, West Chicago, IL 60185.

See at Booth 2228

Circle 570 on Inquiry Card

SIEMENS

Printers should be seen and not heard.

For applications where carbons are not required, Siemens' Ink-Jet Printer should be your only choice.

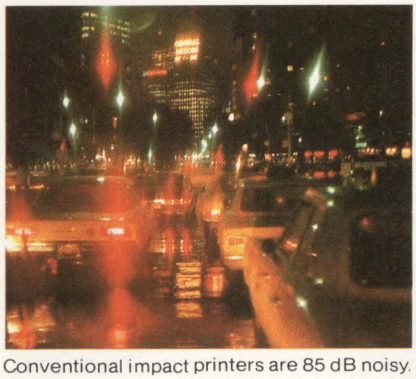
Ink-Jet Printers are much quieter and faster than impact printers. Whereas conventional impact printers make as much noise as a busy traffic street (about 85 dB), the Siemens Ink-Jet Printer is as quiet as a library (about 50 dB). Therefore, for many applications our Ink-Jet Printer is the obvious choice.

No other Ink-Jet Printer can compare with the Siemens PT80i in reliability and cost-effectiveness. It provides high quality bi-directional printing in a variety of type styles, at 270 CPS.

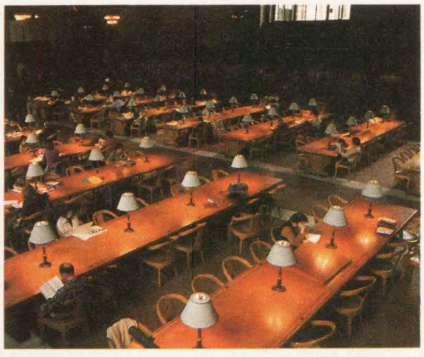
The addition of an extended interface lets you externally connect network selectors, data sets, and storage devices such as floppy disks. The PT80i also features automatic testing for 96 characters with two test programs and LED displays.

Choose the complete terminal in a variety of platen widths, paper feeds, and configurations ... or the module alone ... or the Ink-Jet Print Head with support electronics.

For the full story, quietly told, contact Siemens soon.



Conventional impact printers are 85 dB noisy.



The Siemens Ink-Jet Printer is 50 dB quiet.



District Offices:

Atlanta, GA	(404) 451-8157
Boston, MA	(617) 444-6580
Columbus, OH	(614) 888-3372
Dallas, TX	(817) 461-1673
Iselin, NJ	(201) 494-1000

Siemens Corporation
OEM Data Products Division
240 East Palais Road
Anaheim, California 92805
(714) 991-9700

Siemens. The technology to do more.

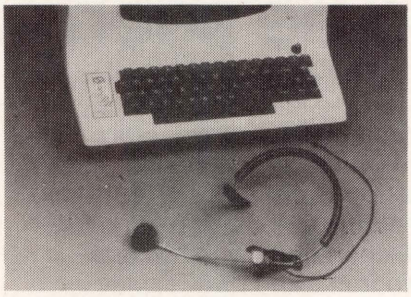
CIRCLE 77 ON INQUIRY CARD

NCC PRODUCT PREVIEW

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SPEECH RECOGNITION SYSTEM FOR CRT TERMINAL

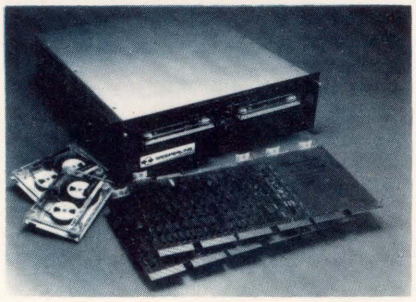


Circle 571 on Inquiry Card

Voice controlled VOCON™ 5000, consisting of a PC board and noise cancelling microphone, transforms Lear Siegler's ADM-3A Dumb Terminal into a voice actuated video display terminal. The device enables any program being run on the computer via the ADM-3A to be performed under voice control. The microprocessor based device recognizes 64 words or phrases at a time; several of these can be stored in the computer's memory. Std recognition rate is 99%. **Heuristics, Inc,** 1285 Hammerwood Ave, Sunnyvale, CA 94086.

See at Booth 1255

DATA CARTRIDGE MAGNETIC TAPE CONTROLLER



TC-180 is a high performance, full DMA controller which is transparent to the DEC operating system because it emulates the DEC TM-11/TU-10 0.5″ (1.3-cm) magnetic tape system. The 6400-bit/in (2520/cm) MFM formatting offers unformatted capacities up to 17M bytes/cartridge, suiting the unit to serve as an 8″ (20-cm) Winchester disc drive. Data are written on 4 tracks in serial mode, 1 track at a time. **Wespercorp, Western Peripherals Div,** 14321 Myford Rd, Tustin, CA 92680.

See at Booth 3207

Circle 572 on Inquiry Card

COMPUTER TERMINAL DESKS

Terminal desks enhance operator efficiency and make the most of floor space. Providing ample leg room for max operator comfort, black steel frames are accented with chestnut wood grain tops and trim. Available in 27 or 30″ (68 or 76-cm) heights, desks are available with 30 x 48 or 60″ (76 x 121 or 158-cm) tops, and a 19″ (48-cm) EIA rackmountable bay, supply drawer, or hinged door cabinet. **Data-MATE, The Maine Mfg Co,** 46 Bridge St, Nashua, NH 03060.

See at Booth 4120

Circle 573 on Inquiry Card

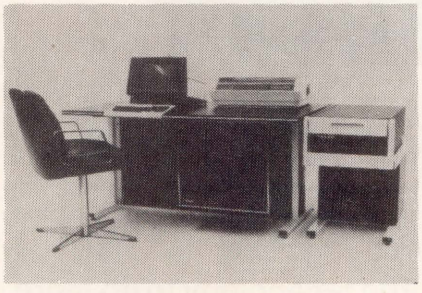
SOLID STATE MASS MEMORY SYSTEM

Line of solid state mass memories is available in capacities of 0.25M, 0.5M, 0.75M, and 1M bytes. Basic building block of the M/CORE system is a 128k-word x 18-bit core module in a single pluggable PC assembly. Each module consists of a 3D/3W folded planar core array, populated with temperature independent cores, integrally mounted on 2 PC boards, which totally enclose and protect the array. Low power TTL Schottky devices minimize power consumption. Each assembly includes its own interface, timing, control, drivers, and sense amplifiers. The various capacities are achieved by installing from 1 to 4 modules in a 9″ (23-cm) high rack-mounted assembly. Cycle time is 3 μs, and access time is 0.75 μs. Selection of each module is position independent; 17 address lines are required to select 1 of 128k words on the selected board. Control signals from the host system define read, write, byte, and read modify write operation. A power ok signal is required to confirm that all voltages are within tolerance. A family of controllers is available for many host computers, allowing add-on enhancement. Typical host disc diagnostics will run without modification at an increased throughput rate. **Alpha Data Inc,** 20750 Marilla St, Chatsworth, CA 91311.

See at Booth 2119

Circle 574 on Inquiry Card

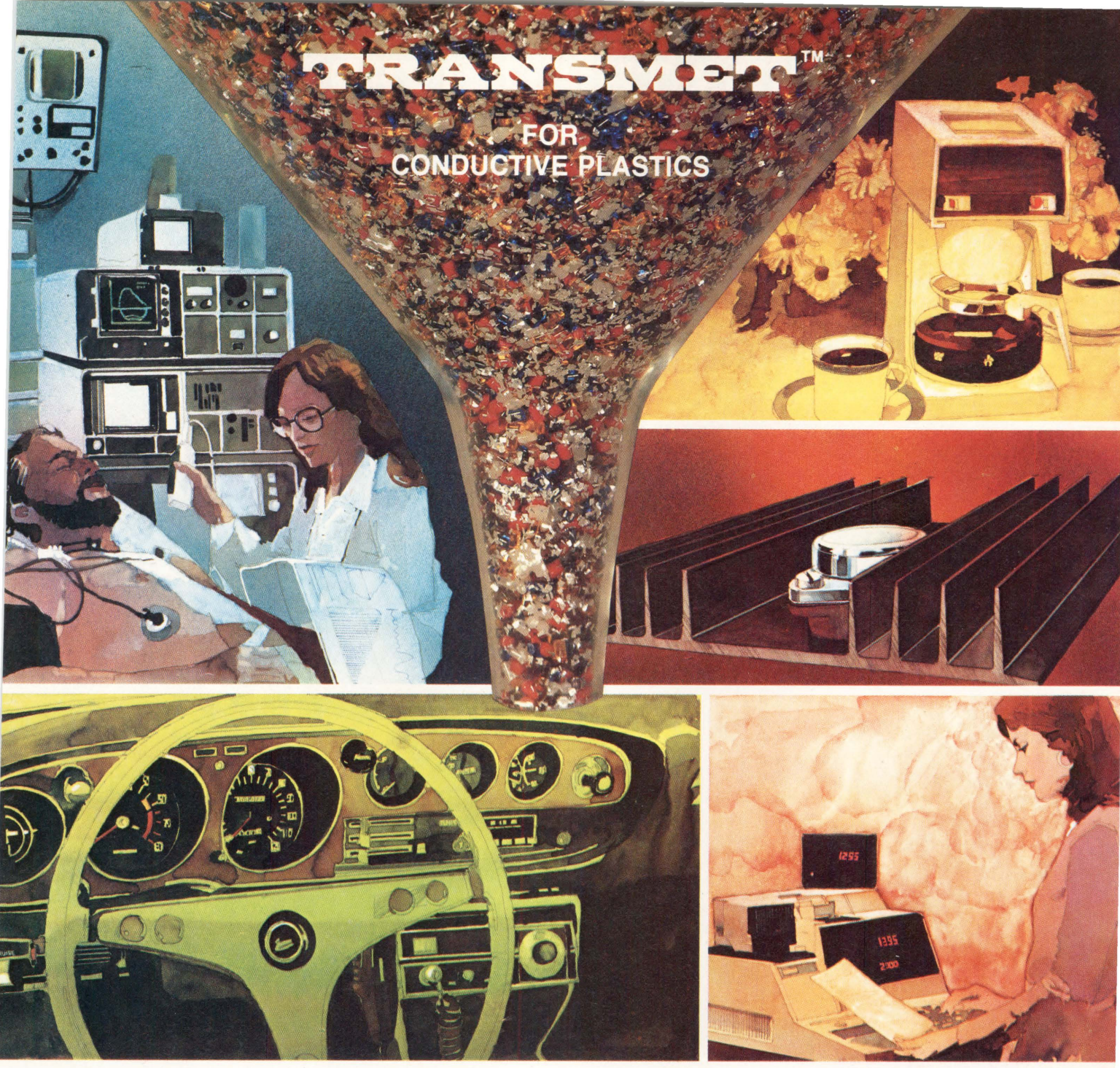
BUSINESS COMPUTER SYSTEM



MICOS 85 includes a central processor with 64k bytes of MOS memory, realtime clock, and automatic program load. Standard features of the basic configuration include 1 MIDAS display terminal, 32M bytes of disc storage (16 fixed and 16 removable), 150-char/s matrix printer, deskware, and MICOS operating system. Options include up to 4 CRTs, an additional 32M bytes of disc, and MTAM, a synchronous communications package using 2780 communications protocol. Video display terminal provides 1920 7 x 9 dot matrix char displayed on 24 lines, 80 char/line, a 12-key numeric pad, and transmission speeds up to 960 char/s. Basic system is expandable to 2 display terminals. MTAM/ASYNC communications package provides asynchronous communications with another system, full error checking, retransmission on error detection, and software compatibility with MTAM/2780 Extensive BASIC programs. **Mini-Computer Systems, Inc,** 399 Fairview Park Dr, Elmsford, NY 10523.

See at Booth 2602

Circle 575 on Inquiry Card



Transmet™ modifiers can give you plastic products with electrical and thermal conductivity.

Now inherent **EMI shielding** is possible using our Series 100 Transmet modifiers as plastic fillers. Equipment such as automotive and aerospace components, business machines, and computers can be housed in light-weight plastic enclosures that are EMI protective.

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The **thermal conductivity** properties of Transmet modified plastics can also be used to advantage. Heat sinks need not be another piece of hardware. They can now be molded as part of the equipment. Similarly, epoxy molds made with Transmet modifiers produce a more uniformly controlled mold temperature and a smoother surface finish than those made with aluminum powder.

If you are a compounder, molder, or equipment manufacturer, you should know more about Transmet modifiers. For detailed applications and design information, write or call for our new brochure on Transmet modifiers.

TRANSMET CORPORATION

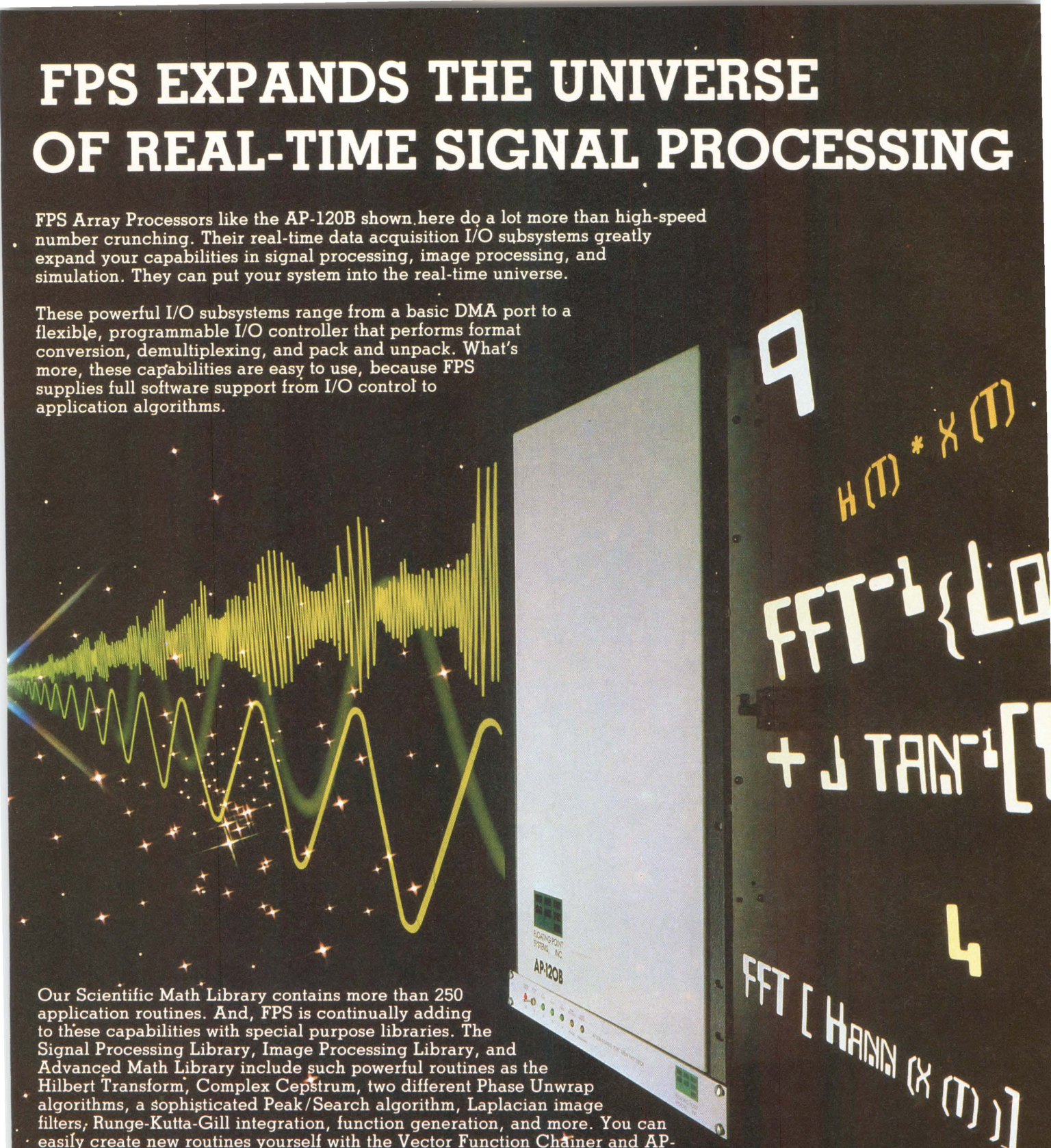
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CIRCLE 78 ON INQUIRY CARD

FPS EXPANDS THE UNIVERSE OF REAL-TIME SIGNAL PROCESSING

FPS Array Processors like the AP-120B shown here do a lot more than high-speed number crunching. Their real-time data acquisition I/O subsystems greatly expand your capabilities in signal processing, image processing, and simulation. They can put your system into the real-time universe.

These powerful I/O subsystems range from a basic DMA port to a flexible, programmable I/O controller that performs format conversion, demultiplexing, and pack and unpack. What's more, these capabilities are easy to use, because FPS supplies full software support from I/O control to application algorithms.



Our Scientific Math Library contains more than 250 application routines. And, FPS is continually adding to these capabilities with special purpose libraries. The Signal Processing Library, Image Processing Library, and Advanced Math Library include such powerful routines as the Hilbert Transform, Complex Cepstrum, two different Phase Unwrap algorithms, a sophisticated Peak/Search algorithm, Laplacian image filters, Runge-Kutta-Gill integration, function generation, and more. You can easily create new routines yourself with the Vector Function Chainer and AP-FORTRAN compiler, or program at the assembly language level.

Investigate this new power in real-time computing. Over a thousand FPS Array Processors are in use today by people who require the real-time throughput of a mainframe but want the hands-on control and affordability of a minicomputer system. FPS is ready to expand your real-time universe. Contact FPS or our sales office in your area to find out how.

See FPS at NCC
Island 2452, Anaheim, CA, May 19-22

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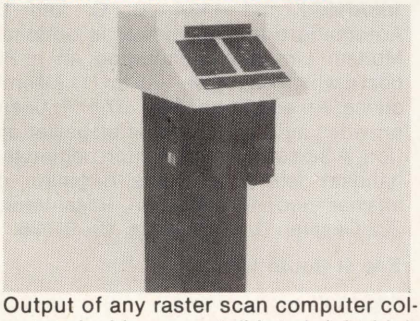
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Circle 79 For More Information

Circle 325 For Contact by FPS

NCC PRODUCT PREVIEW

COMPUTER TERMINAL OUTPUT COLOR GRAPHIC CAMERA



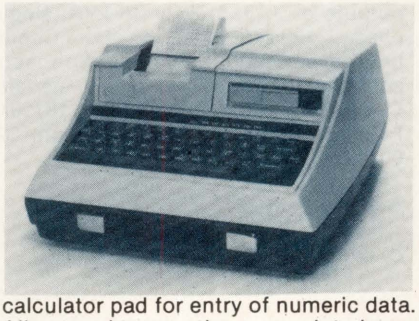
Output of any raster scan computer color terminal is converted into bright high resolution photographic hardcopy with the Color Graphic Camera System. Both line and continuous tone images can be made with accurate bright, saturated colors. Model 4000 produces instant, on the spot hard copies on Polaroid 8 x 10″ (20 x 25-cm) film, 8 x 10 color transparencies for overhead projection and backlit display, 35-mm color slides, 60-image color microfiche, or 16- or 35-mm color animation films. The system can record 1, 2, 4, 6, 9, 16, or 25 (slide-size) images on a single sheet of 8 x 10 film, allowing related and sequential images to be arranged in orderly arrays, simplifying comparison and analysis. System consists of built-in high resolution, flat faced monochrome video monitor, red/green/blue color filter mechanism, optical system, 8 x 10 film back, microfiche film back, and auxiliary port for 35-mm, Polaroid SX-70, animation camera, or other specialized photography. Microprocessor based electronics provide automation and calibration features as well as color separation, self-diagnosis, and remote control. **Matrix Instruments, Inc,** 230 Pegasus Ave, Northvale, NJ 07647.

See at Booth 2327

Circle 576 on Inquiry Card

REMOTE BATCH DATA ENTRY TERMINAL

Series 400 Alpha-verter consists of five main modules: 55-key alphanumeric keyboard with embedded calculator keypad, hard copy printer, mag tape cartritape, integral acoustic coupler, and microprocessor control circuitry. Data are accepted in free format or under program control. Latter allows operator prompting on either printer or optional CRT display. Keyboard accepts alpha data normally, and can shift either by mannual or program control to activate

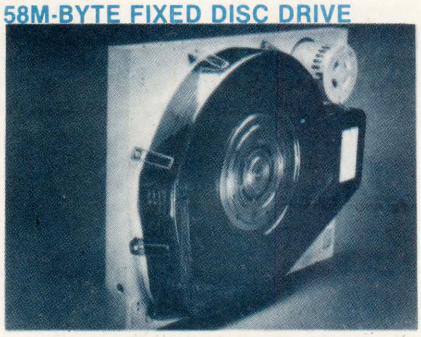


calculator pad for entry of numeric data. All entered transactions are printed on a journal tape and are recorded on the 87k-char cartritape for later transmission. Alpha-verter will transmit recorded data either via acoustic coupler, through a remotely polled DAA, or by an RS-232-C (V.24) port into a modem. Transmission is asynchronous ASCII at 1200 baud. Integral personality P/ROM will custom tailor operating characteristics to user's particular requirements. **Digitronics Div, Comtec Information Systems Inc,** 53 John St, Cumberland, RI 02864.

See at Booth 2464

Circle 577 on Inquiry Card

58M-BYTE FIXED DISC DRIVE



58M-byte 14″ (35-cm) SA4100 Winchester fixed disc drive doubles capacity of its predecessor to meet extensive mass storage requirements and offer lowest cost/megabyte in its capacity range. With an additional 2 discs and 8 heads, the unit retains the size of the SA4000 series, mounting in a 19″ (48-cm) RETMA rack while using only 5.25″ (13.33 cm) of panel space. Weight is 40 lb (18 kg), lighter than similar units. Key performance specs include transfer rate of 7.1M bits/s, avg access time of 65 ms, and avg latency of 10.1 ms. Error rates are 1 per 10^{10} bits for soft read, 1 per 10^{12} for hard read, and 1 per 10^{6} for seek errors. Recording density is 5535 bits/in (2178/cm) with track density of 172 tracks/in (67/cm). MTBF is 8000 power-on hours. Unit operates without preventative maintenance and offers component design life of 5 yr. Product reliability and serviceability is enhanced by incorporating all electronics on single PC board. **Shugart Associates,** 435 Oakmead Pkwy, Sunnyvale, CA 94086.

See at Booth 2462

Circle 578 on Inquiry Card

MULTIPORT PROTOCOL CONVERTER AND INTERFACE

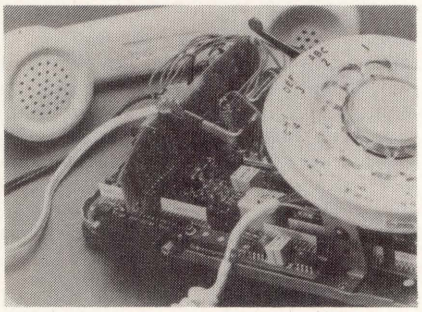
MCS-80 enables communication of data between multiple computers or terminals using different line discipline protocols. Self-contained converter is completely transparent and connects to terminals of most IBM, Univac, Honeywell, Burroughs, and NCR computers. MCS-40 is an 8085 microprocessor based interface board with all external connections mounted. Diagnostics and self-testing are provided. **Innovative Electronics Inc,** 15200 NW 60 Ave, Miami Lakes, FL 33014.

See at Booth 1753

Circle 579 on Inquiry Card

NCC PRODUCT PREVIEW

MODEM HOUSED IN STANDARD TELEPHONE



VA103 ModemPhone features a switched network 300-bit/s full duplex Bell 103/113 compatible modem housed inside a std telephone. The unit, with built-in FCC registered direct connect, originate/answer modem, plugs into a std telephone company voice jack (RJ11C) or programmable data jack (RJ41S or 45C) and connects to data terminal. Equipped with an 8′ (3 m) cable and Telco matching plug, and 25-pin connector to accept RS-232-C interface from the terminal, modem mounts inside a rotary or Touch-Tone telephone, eliminating need for separate modem and associated interconnect circuitry. It is a direct replacement for Bell 103A/103J and 113A, B, C, and D. Automatic originate/answer is optional. Modem circuitry is mounted on a PC board which occupies 17.5 in² (112.9 cm²) space. An additional 6-in² (37-cm²) board provides automatic originate/answer option. A 3-position slide switch behind the handset determines voice, originate, or answer mode of operation. **Racal-Vadic,** 222 Caspian Dr, Sunnyvale, CA 94086.

See at Booth 1838

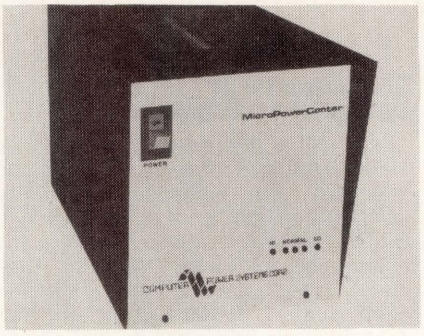
Circle 580 on Inquiry Card

INPUT POWER ISOLATOR/REGULATOR

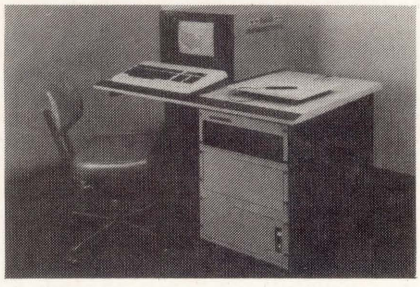
Terminal and mini- and microcomputer downtimes due to powerline fluctuation, disturbances, and transients are reduced by the MicroPower series computer power interfaces. Interposed between wall outlets and the equipment, units isolate, regulate, and filter standard power. They provide brownout protection against as much as 22% low line voltage and also protect against line voltages up to 15% over nominal supply. Abnormally high or low supply voltages trigger an audible/visual alarm system, sounding an alarm and causing a red LED to flash on the control panel. Normal conditions are indicated by a constant green LED. Series is available with outputs of 1, 3, 5, 8, or 10 kVA, single phase, 120/240 Vac, 60 Hz. Circuit breaker protection is standard on input and output receptacles on all models. **Computer Power Systems Corp,** 18150 S Figueroa St, PO Box 6240, Carson, CA 90749.

See at Booth 2612

Circle 581 on Inquiry Card



PASCAL PROGRAMMABLE COLOR GRAPHICS COMPUTER

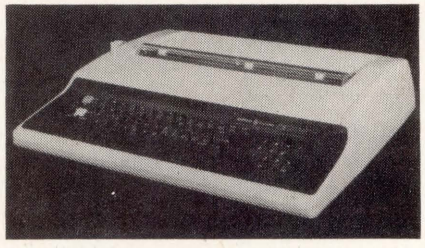


High resolution, high performance 6214 Colorgraphic Computer system offers 4 times the resolution, 8 times the color selection, and 25 times the vector writing speed of other models, as well as both 30- and 60-Hz memory refresh rates. The system is hardware and software compatible with the 6114, allowing easy upgrade. It offers resolution of 640 x 480 picture elements. Four refresh memory planes under control of a software loadable video lookup table support up to 16 displayable colors from a total of 64 possible. Lookup table also allows film loop animation and raster smoothing operations to be performed in software via user programming. In basic configuration, unit consists of Z80 CPU operating at 4 MHz with 64k programmable memory, floppy disc controller, 250k/512k-byte floppy disc drive, color monitor, keyboard, pedestal display unit, and Pascal operating system. **Ramtek Corp,** 2211 Lawson Lane, Santa Clara, CA 95050.

See at Booth 1127

Circle 582 on Inquiry Card

TABLETOP MATRIX PRINTERS



Circle 583 on Inquiry Card

TermiNet[R] 2000 impact matrix printer family incorporates a 7 x 9 dot matrix printhead with blade mounted pins to insure low sound levels and long life. The 2030 prints 30 char/s, with a 60-char/s catchup rate; the 2120 prints 120 char/s with a 150-char/s rate. Dc servomotor controlled printhead mechanism allows bidirectional printing without fill chars. Print density is selectable at 10, 13.2, and 16.5 char/in (4, 5.2, 6.5 char/cm) along a 13.2″ (33.5-cm) line. Ribbon cartridge is stationary; a stepper motor drives the Mobius loop ribbon. Ribbon life is approx 3M char. Printers process up to 3 copies including the original, producing 2, 3, 4, 6, 8, and 12 lines/vertical in (0.8, 1.2, 1.6, 2.4, 3.1, and 4.7 lines/cm) with a 5-in (13-cm)/s slew rate. Microprocessor scanned keyboard uses capacitive key switches. An ANSI typewriter paired arrangement is std, with ANSI/APL layout optional. **General Electric Co, Data Communication Products Dept,** Waynesboro, VA 22980.

See at Booth 4031

GET A GREAT START ON SYSTEM PERFORMANCE WITH PERIPHERAL DYNAMICS READERS

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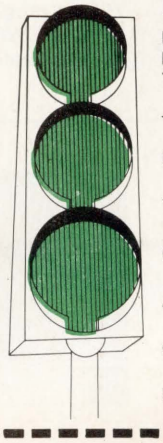
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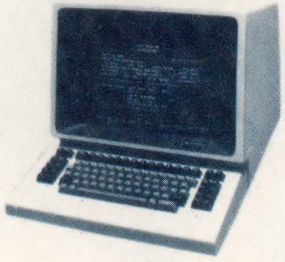
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CIRCLE 81 ON INQUIRY CARD

15″ VIDEO DISPLAY DATA INPUT TERMINAL



A high resolution 15″ (38-cm) video display, the 1685 keystation features green char on a black background, with a max of 1920 displayable char. The last line on the screen displays the current cursor position and any status conditions. Thumbwheel switches control brightness and contrast of the video screen. Keyboard types that are supported include typewriter, extended typewriter, data entry, extended data entry, and optional extended data entry with a 10-key numeric pad located to the right of the std keypad. Keyboards can be placed up to 18″ (46-cm) from the video unit. A self-diagnostic microprogram exercises the keystation each time the power is turned on, or by manually activating a switch on the front of the unit. It performs basic test operations of the processor board, keyboard, and audible alarm. Line speeds up to 9600 bits/s can be handled. **Harris Corp, Data Communications Div,** 16001 Dallas Pkwy, Dallas, TX 75240.

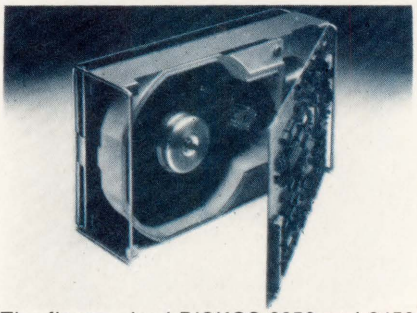
See at Booth 2635

Circle 584 on Inquiry Card

NOTE

1000 series booths are located in North Hall at the Anaheim Convention Center, 2000 series numbers are in South Hall, 3000 series in the Arena, and 4000 series in the West Hall. Booths 1 through 178 are part of the Personal Computing Festival and are located at the Disneyland Hotel Convention Center. Booths 201 to 999 are NCC exhibitors that are located in the Disneyland Hotel Lower Level Exhibit Hall.

8″ WINCHESTER DISC DRIVES

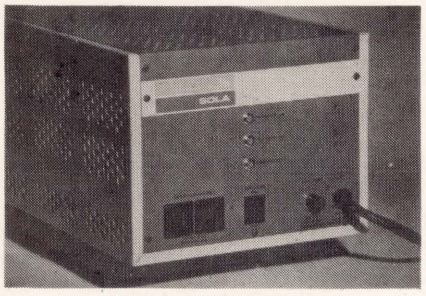


The floppy sized DISKOS 2050 and 3450 have capacities of 20M and 34M bytes, respectively. Based on the design and interface of the company's 14″ (35.5-cm) disc drives, the 2 units employ a full servoed voice coil positioner and a brushless dc motor. Data separation and MFM encoding/decoding circuits are onboard. Two 8″ (20-cm) discs are used in the 2050; 3 are used in the 3450. Avg access time is 50 ms and track to track access is 10 ms. Avg latency is 6.4 ms. **Priam,** 3096 Orchard Dr, San Jose, CA 95134.

See at Booth 347

Circle 585 on Inquiry Card

UPS FOR SMALL EQUIPMENT



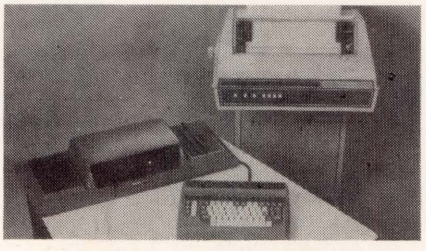
A portable plug-in uninterruptible power source system designed to protect small electronic equipment from ac power line problems, MINI-UPS is available in 400-and 750-VA models, for use with POS terminals, communications equipment, and microcomputers. In a single enclosure, system houses a sealed maintenance free lead-acid type battery. In a blackout situation, the 400-VA unit provides up to 20 min of regulated power to the load from its battery backup. The 750-VA model provides 10 min of battery reserve. When drained, batteries are automatically recharged to 95% of full potential in less than 10 times the discharge time. The system continuously responds to ac line fluctuations, actively regulating output voltage and isolating load from transients and brownout conditions. It operates from single-phase 115-Vac input and provides output voltage regulated to ±3% of nominal through input fluctuations as great as +10 to −20%. **Sola Electric,** 1717 Busse Rd, Elk Grove Village, IL 60007.

See at Booth 4422

Circle 586 on Inquiry Card

DATA COMMUNICATION SYSTEM

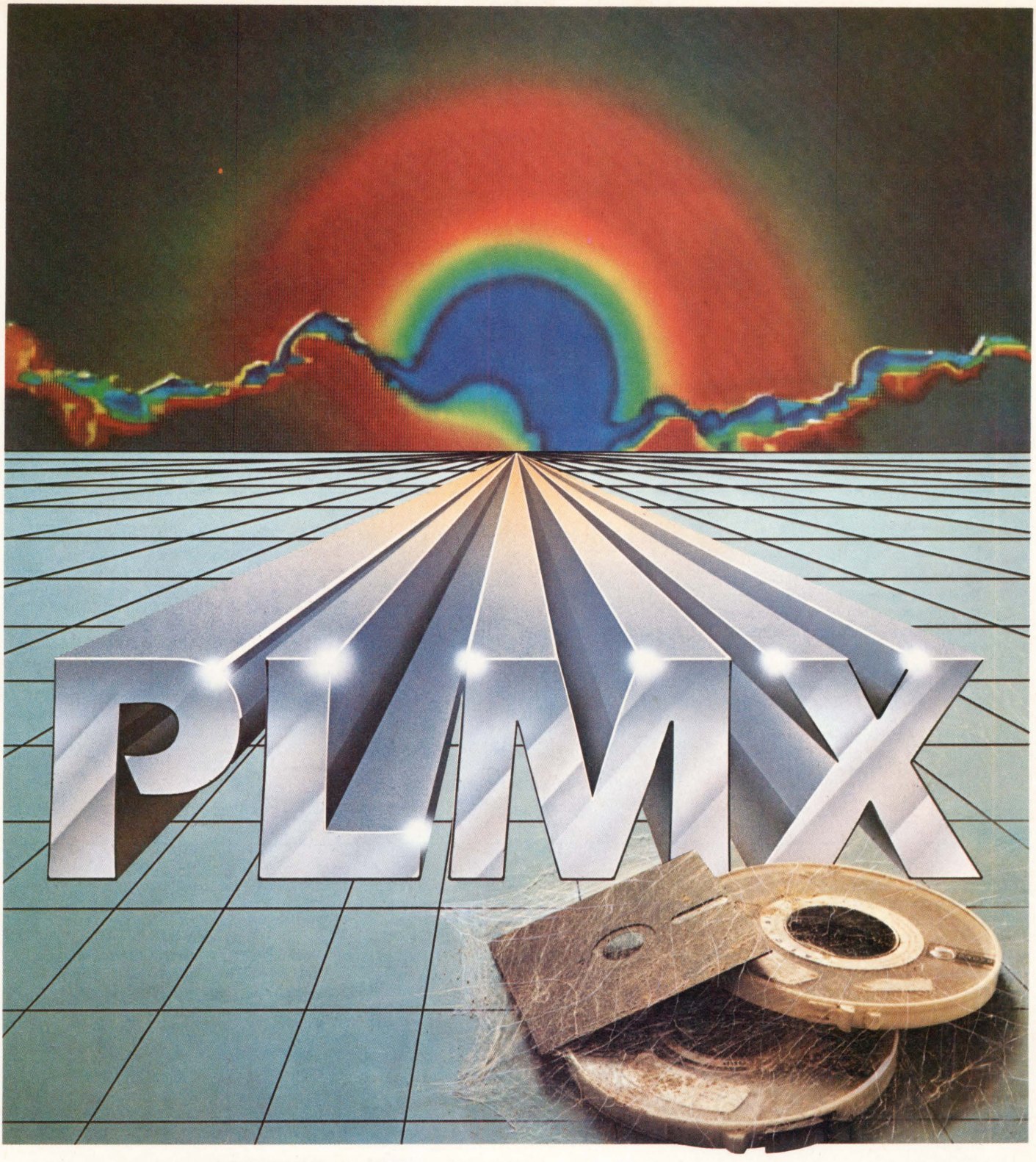
Intended for remote batch data collection, the 700-80 is a single-source communications package which includes a data collection station; printer; 1200-, 2400-, or 4800-baud modem; and telephone handset. Requiring no programming, the system comes ready to



use. Features include multiprotocol selection—IBM 2770, 2780, 3780, and 3741; bisynchronous transmission; and unattended operation. It may also be used interactively with a computer. **TAB Products Co,** 1451 California Ave, Palo Alto, CA 94304.

See at Booth 1207

Circle 587 on Inquiry Card



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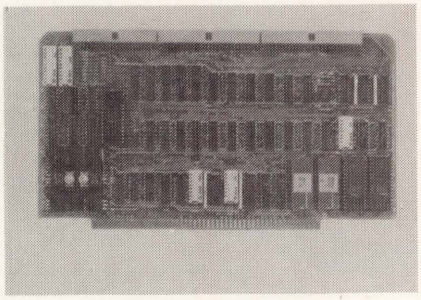
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CIRCLE 82 ON INQUIRY CARD

NCC PRODUCT PREVIEW

MICROCOMPUTER PRINTER INTERFACE



Allowing use of either letter quality printers and/or high speed line printers within the same microcomputer configuration, the I/OMaster™ S-100 board interfaces easily with low cost OEM versions of NEC, Diablo, and Qume printers, and with high speed Centronics and Dataproducts units. Combining 4 boards in 1, the interface features 2 each serial and parallel ports as well as an 8-level interrupt control and dual-interval timer circuitry. To insure that keystrokes and transmitted communication data are not lost during disc I/O and MP/M task switching operations, the 8251 based serial ports each have built-in 32-char FIFO buffers. All options are DIP switch selectable. Also shown will be DataStar™ word processing software, which is a forms control oriented, general purpose data entry, retrieval, and update system designed for office use. Keyboard input format is designed for high volume production, and dynamically displayed menu of operator prompting is designed for easy learning. A comprehensive set of facilities are provided. **MicroPro International Corp,** 1299 Fourth St, San Rafael, CA 94091.

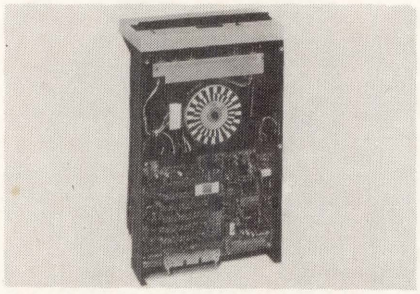
See at Booth 16

Circle 588 on Inquiry Card

NOTE

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MAGNETIC TAPE SUBSYSTEMS



MT-100 series subsystems are compact versions of the higher performance 6250-bit/in, 200-in/s (2460-bit/cm, 508-cm/s) magnetic tape subsystems. Tape speeds range from 50 to 125 in/s (127 to 317 cm/s) with recording densities to 6250 bits/in (2460/cm) GCR, 1600 bits/in (630/cm) PE, and 800 bits/in (315/cm) NRZI. The ANSI compatible subsystems have automatic tape threading mechanisms and front maintenance access; they mount in std EIA racks. **Hitachi America, Ltd,** 100 California St, San Francisco, CA 94111.

See at Booth 4309

Circle 589 on Inquiry Card

CARTRIDGE FORMATTER FOR DISC BACKUP TRANSPORT

Advanced data recovery system of the microprocessor based formatter, for use with the model 640 8″ (20-cm) disc backup cartridge transport, employs GCR techniques to reduce host computer overhead while improving data integrity. Model 650 simplifies peripheral controller design since the same bus and signal conventions are used for both disc drive and backup cartridge controllers. The formatter is integral to the 6400-bit/in (2520/cm), 4-track, serpentine cartridge drive. Capacity on a 450′ (137-m) DC300A cartridge is 17.3M bytes unformatted or 15M bytes formatted, with 10k-byte records. Components include an 8-bit MOS microprocessor and 2-speed bipolar microsequencers. Special routines sense broken tape or loss of tape from the reels. GCR encoding techniques are employed in place of MFM because of the ±0.5 cell recovery margins, unique char for file partitioning, and expansion possibilities for burst error correction and data resynchronization. A hardware implemented 16-bit CRC char, written by the formatter, adds further data integrity. **Kennedy Co,** 1600 S Shamrock Ave, Monrovia, CA 91016.

See at Booth 2115

Circle 590 on Inquiry Card

6400-BIT/IN CARTRIDGE TAPE DRIVE



Model 400 operates with DC300A, DC300XL, DC600, or equivalent at a density of 6400 bits/in (2519/cm) to provide unformatted storage capacity of up to 23M bytes/cartridge. Motion is imparted from motor capstan to cartridge via one-to-one ratio idler. Design eliminates motor hinging systems and provides positive position lock for cartridge when in place. All onboard mechanisms—head, tape mark sensor, cartridge in place switch, and write protect switch—are mounted directly to deck plate. Configured for 4-track serial operation, electronics, including servo and read/write data and control logic, are located on modular PC boards. Power transistors are attached to rear mounted heat sink away from cartridge. When supplied with optional control card, unit has fully compatible interface to Western Peripherals' tape cartridge controller. Up to 8 drives may be bused using the card. Without the card, the interface is at the servo card, and is configured with open collector TTL level drivers and terminators. **Qantex,** 60 Plant Ave, Hauppauge, NY 11787.

See at Booth 1647

Circle 591 on Inquiry Card

Lift your DEC® to new heights
Add-on a Miproc



Plug a MIPROC-16AP into your PDP-11® to give yourself a computer system with formidable power.

Power for Pre/Post Processing
Miproc's architecture and instruction set give you 4 million instruction/sec to deal with data on the fly. (Analog interfaces are available)

Power for Input/Output
256 directly addressable I/O channels and 1M word/sec programmed I/O rate relieves your system of I/O overheads.
(DMA at up to 20 M bytes/sec)

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Add memory-register in 250ns, multiply in 4 to 8us, or 1.5us with hardware multiplier. (Optional Floating Point unit multiplies 32 bit numbers in 3.5us)

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To discover more about how MIPROC-16AP will boost your PDP-11 system performance, contact us.

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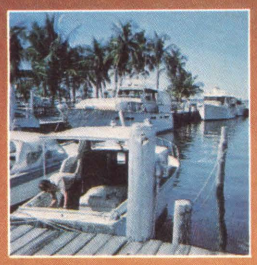
PLESSEY MICROSYSTEMS

1641 Kaiser Ave. • Irvine, Calif. 92714
(714) 540-9931

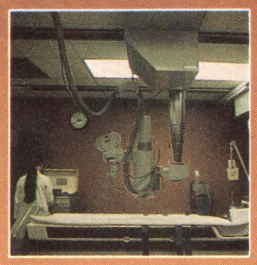
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Now you can protect your circuit with the switch that turns it on.

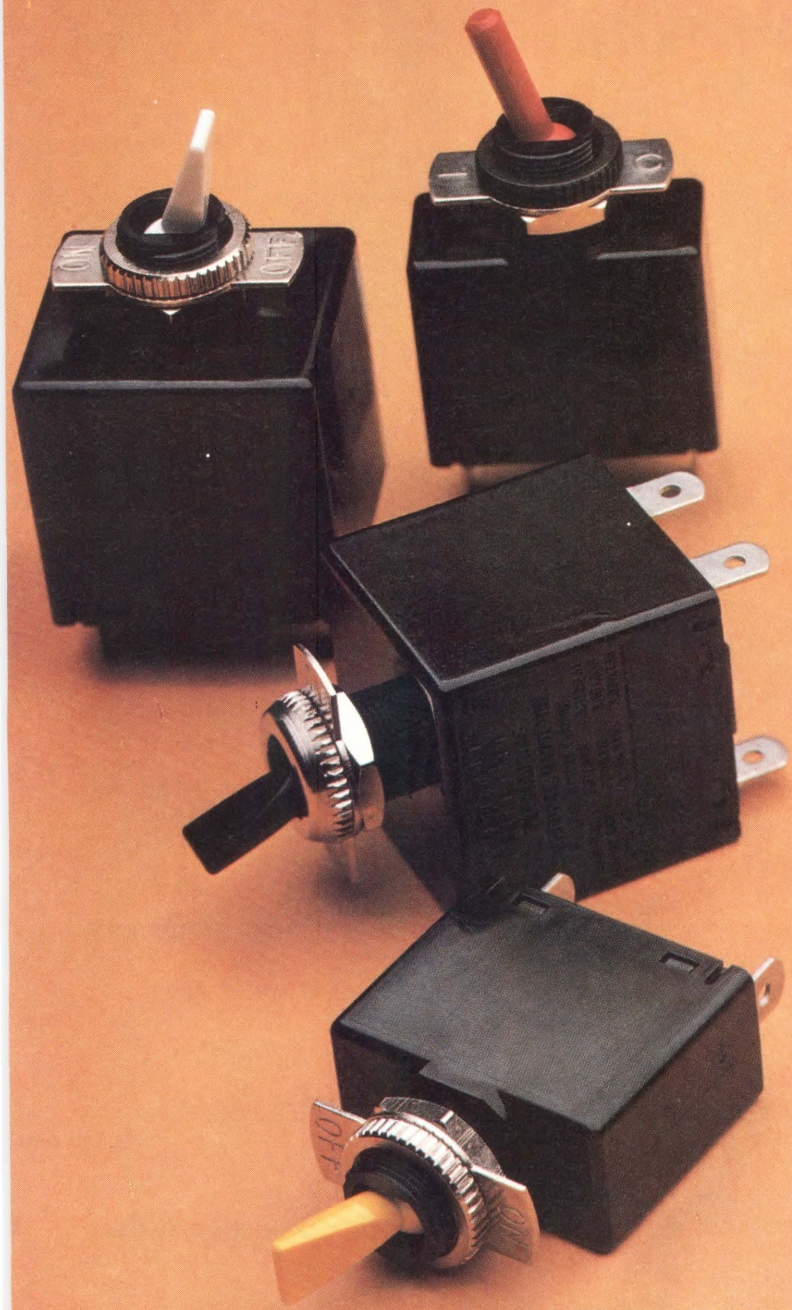
The new AIRPAX SNAPAK® circuit breakers look and operate like switches, but their performance doesn't stop there. They are also snap-acting magnetic circuit breakers that can protect your product and its components from damaging power surges and faults.

For products that never had circuit protection before, the SNAPAK breakers are a great idea—they feature easy, single-hole mounting, they're available in a wide range of delay characteristics and current ratings, plus they come in a choice of baton or paddle handles in six attractive colors.

For products that previously used fuses and thermal devices, they're a better alternative—they eliminate extra stocking and assembly of multiple components, they save space and they reduce product wiring requirements.

You can order SNAPAK circuit breakers in SPST and DPST configurations (they're the only snap-action DPST circuit breakers around). There are shunt and relay versions available. And you can choose from a complete selection of mounting hardware to match your product's panel aesthetics.

All the facts about AIRPAX SNAPAK circuit breakers are contained in our new brochure. To get your free copy, contact us at: AIRPAX, Cambridge Division, Woods Road, Cambridge, MD 21613. Telephone: (301) 228-4600. Or circle our reader service number.



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NCC PRODUCT PREVIEW

900-CHAR/s MATRIX PRINTER



See at Booth 1155

Model PB-600C printer, using a 15-char/in (6/cm) compressed font, prints 900 char/s. At 10 char/in (4/cm), the device prints 600 char/s. The bidirectional printer's high performance printhead provides several billion char with no duty cycle restriction. Full 96-char set and elongated char are available in both std and compressed fonts. Either 6 or 8 lines/in (2 or 3 lines/cm) are switch or program selectable. Multipart forms may consist of an original and up to 7 carbons. **Florida Data Corp,** 3308 New Haven Ave, Melbourne, FL 32901.

Circle 592 on Inquiry Card

LSI-11/23 CARTRIDGE DISC BASED SYSTEMS

By using the LSI-11/23 CPU, System 13V combines the instruction set of the PDP-11/34 with the Q-Bus. Featured are integral memory management for a max of 256k bytes of addressable memory, 4-level interrupt protocol, parity check, and optional floating point. A variety of configurations offers a choice of 5M-, 10M-, or 27M-byte disc cartridge subsystems. **Plessey Peripheral Systems,** 17466 Daimler, Irvine, CA 92714.

See at Booth 3118

Circle 593 on Inquiry Card

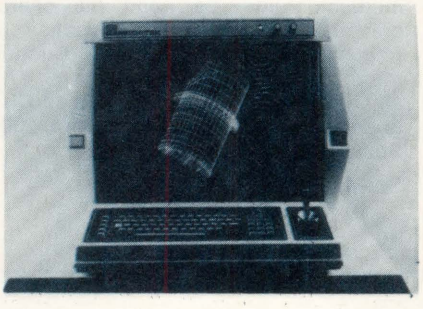
2-PHASE STEPPING MOTOR

Permanent magnet, square-face stepping motor provides up to 10 oz (0.28 N) of torque and up to 10-kHz stepping rates. With a 3.6° ±5% noncumulative step angle, it measures only 1.653 x 1.653 x 1.339″ (42 x 42 x 34 mm). Available in 18-Ω (320-mA/phase) and 75-Ω (150-mA/phase) models, RDM 253/25 comes with iron end caps to limit emi to <5 G. **Berger-Lahr Corp,** Fitzgerald Dr, Jaffrey, NH 03452.

See at Booth 2551

Circle 594 on Inquiry Card

COLOR RASTER GRAPHICS TERMINAL

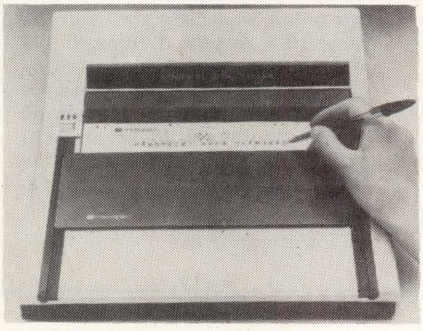


Whizzard 7250 parallel raster terminal, first member of the 7200 family of graphics systems, offers higher speed than standard raster color terminals, as well as enhanced resolution on its 512 x 512 screen. Using an advanced graphics processor, it provides more powerful animation and dynamic capabilities than any raster device currently available. Whizzard 7000 and other graphics products will also be displayed. **Megatek Corp,** 3931 Sorrento Valley Blvd, San Diego, CA 92121.

See at Booth 1115

Circle 595 on Inquiry Card

HANDPRINT INPUT COMPUTER TERMINAL



Micropad, a computer terminal which can accept and recognize handprinting in either ballpoint or pencil, has a built-in microprocessor which recognizes each handwritten character, converts it into ASCII code, and transmits it to the host computer via an RS-232/V.24 or current loop interface. A choice of 4 character transmission rates is provided. As each character is accepted by the host, it can be displayed on the terminal's 40-char dot matrix display. **Micropad Ltd, sub of Quest Automation,** Whittle Rd, Ferndown, Dorset BH21 7SD, England.

See at Booth 4001

Circle 596 on Inquiry Card

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MATRIX PRINTERS



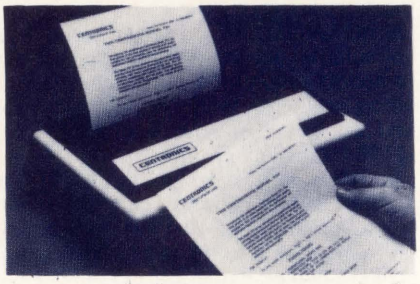
Slimline SLG graphics unit offers choice of 7 x 9 and 7 x 12 matrices for high density alphanumeric char, or 7 x 5 and 7 x 6 matrices for low density char as well as 100 x 100 dots/in (40 x 40/cm). The device prints low density output at 400 lines/min and high density for correspondence at 120 lines/min. Graphics are printed at a plotting speed of 12″ (30 cm)/min. The printer reproduces whatever can be displayed on a CRT screen, including areas of solid black. Graphs, maps, bar charts, and labels can be printed in addition to Arabic, Chinese, and Farsi. **Okidata Corp,** 111 Gaither Dr, Mt Laurel, NJ 08054.

See at Booth 2227

Circle 597 on Inquiry Card

NCC PRODUCT PREVIEW

SMALL BUSINESS COMPUTER PRINTER



Latest in the company's 700 series printer family, model 737 features proportional spacing, right margin justification, forward and reverse paper motion, and 3-way paper handling. The microprocessor based device prints 7 x 8 dot matrix characters at 10 and 16.5 char/in (4 and 6.5/cm) for standard EDP tasks and generates n x 9 characters in proportional spacing for data and text processing, using a 9-wire free flight printhead. A full line buffer is provided. Manual or software control allows paper to be rolled forward or backward in half-line steps to accommodate super- or subscripts. The printer accepts letterhead, or 80-col roll or fanfold paper. Print speed is 21 lines/min (80 col) and 58 lines/min (20 col). Mobius loop arrangement of continuous ribbon allows printing on upper and lower portion on alternate passes. Dimensions, less roll paper holder, are 14.5 x 11 x 4.89″ (37 x 28 x 13 cm) and weight is under 12 lb (5.4 kg). **Centronics Data Computer Corp,** Hudson, NH 03051.

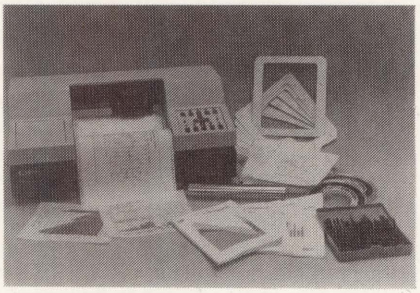
See at Booth 1548

Circle 598 on Inquiry Card

BUSINESS GRAPHICS SYSTEM

Crisp, effective 4-color graphs are produced on 8.5 x 11″ (21.5 x 28-cm) continuous fanfold paper or clear acetate film for overhead projection by the business graphics system. At the heart of the system is the model 1453B 12″ (30-cm), 4-pen plotter with microcomputer based controller. It is designed for use with continuous feed paper for unattended multiple-plot operation. The plotter is equipped with either RS-232 or IEEE-488 interface for connection to a variety of computers and terminals using either a direct communications port or a modem connection. The plotter is driven by ZCHART, an interactive business graphics software package. It produces multicolor line, bar, and pie charts created from the user's response to English language questions. Dialogue may be conducted using any alphanumeric terminal; a graphics CRT is not required. **Nicolet Zeta Corp,** 2300 Stanwell Dr, Concord, CA 94520.

See at Booth 2265



Circle 599 on Inquiry Card

UNINTERRUPTIBLE POWER SYSTEM



See at Booth 2501

Rated at 120 kW/150 kVA, UPS can be supplied with all std 50-Hz voltages and provides power outage protection from 1 min to 1 h or more depending on battery selection. The system is designed for common battery operation with the company's isolated redundant 415-Hz systems. Packaging consists of a 70 x 35 x 78″ (178 x 90 x 198-cm) main cabinet and a smaller separate switchgear cabinet. Controls and indicator lights are arranged in a mimic bus format. **International Power Machines Corp,** PO Box 746, Mesquite, TX 75149.

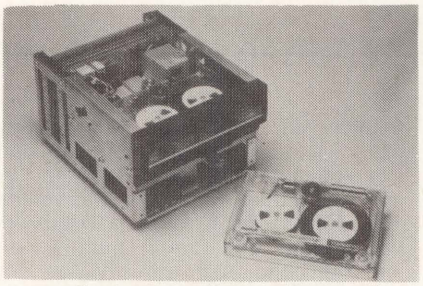
Circle 600 on Inquiry Card

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75M-BYTE DATA CARTRIDGE SYSTEM

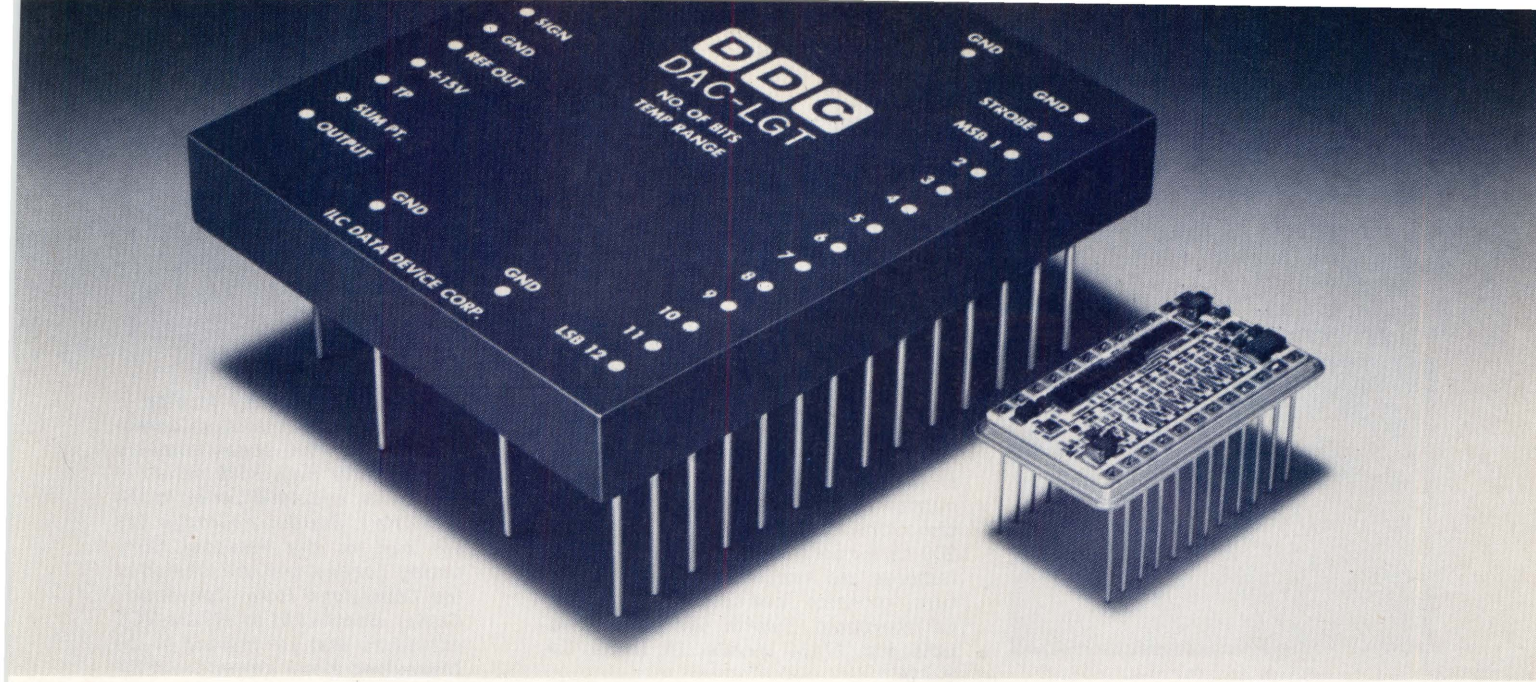
HCD-75 high capacity cartridge drive and DC600HC cartridge provide 75M bytes of user data storage capacity (total tape capacity of 144M bytes includes formatting), more than any current 0.25″ (0.64 cm) cartridge system. This coupled with a continuous information transfer rate of 20k bytes/s, makes the system suitable for backup for Winchester disc drives. Capacity is achieved through the combination of a 16-track drive, special



magnetic tape, and recording method. The drive uses a single-track ceramic read/write head. A microprocessor controlled servo mechanism positions the head to address 1 of 16 tracks across the tape width. Data are written or read in serpentine mode to eliminate rewinding. Microprocessors are used for drive control, diagnostic self-test, and error detection and correction during read functions. **3M Co, Mincom Div,** PO Box 33600, St Paul, MN 55133.

See at Booth 3000

Circle 601 on Inquiry Card



MAXIMUM SPEED. MINIMUM GLITCH.

DAC-LGT & ADH-030. The world's fastest voltage and current output DACs.

D/A converters for automatic test equipment, large-screen CRTs and video reconstruction have got to be fast—with the lowest possible glitch. On both counts, DDC comes through with the fastest low-glitch DACs available anywhere.

Take our 12-bit DAC-LGT module. It features a strobed digital input register and a choice of outputs to ±10 V. The update rate is 20 MHz; the settling time only 400 ns. And it's manufactured to MIL-STD-202E. So it's tough enough for the most demanding military, aerospace and industrial applications.

The same goes for our 12-bit thick film hybrid, the ADH-030. Not only is it the world's fastest current output DAC, the sealed 24-pin DIP is processed to MIL-STD-883, Class C, for reliability. Its glitch energy is a very low 2.5 mA-ns and the settling time is only 30 ns. To get all the facts on these tough, fast, low-glitch DACs, call or write ILC Data Device Corporation.

DDC

ILC DATA DEVICE CORPORATION

EXECUTIVE OFFICES: ILC Data Device Corporation, Dept. F-1, 105 Wilbur Place, Bohemia, N.Y. 11716, (516) 567-5600, TWX: 510-228-7324.
LOS ANGELES: ILC Data Device Corporation, Dept. F-1, 7337 Greenbush Avenue, No. Hollywood, CA 91605, (213) 982-6454, TWX: 910-499-2674.
LONDON: DDC United Kingdom Ltd., Dept. F-1, 128 High Street, Hungerford, Berkshire, RG17 ODL, England (44) 4886-2141/2142, TLX: 851-848826.
PARIS: DDC Electronique, Dept. F-1, 4 Rue De Abreuvior, 92400 Courbevoie, France, TLX: 842-630609.

"See us at Electro '80, Booth #2342 and #3220."

CIRCLE 85 ON INQUIRY CARD

NCC PRODUCT PREVIEW

32-BIT COMPUTER SYSTEM



Circle 602 on Inquiry Card

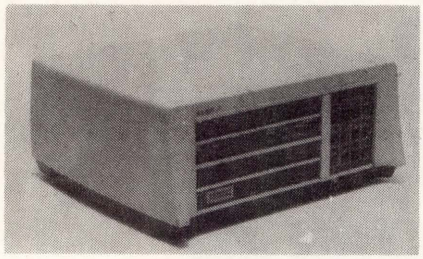
T-85 mainframe is transparent to all Xerox developed software including the TCP-V and TCP-R operating systems. It is hardware plug compatible with all existing Sigma memory modules, mass storage facilities, peripherals, and communications equipment. Microcoded instructions provide execution times of 200 ns for each microinstruction. Other features are simplified 2-bus architecture, control console, and a std CRT/keyboard. **Telefile Computer Products, Inc,** 17131 Daimler St, Irvine, CA 92714.

See at Booth 2249

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INTELLIGENT TERMINAL CONTROLLER

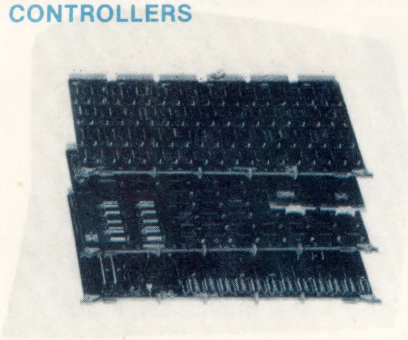


The AJ 410 intelligent terminal controller, which acts as an electronic mailbox, provides for the buffering, editing, storage, and transmission of up to 32k char of data. It increases communications efficiency by allowing high speed traffic to flow between buffers without operator intervention, reduces operator training time with English language commands, and increases operator productivity with automatic message formatting and text editing capabilities. Dynamic buffer allows simultaneous message preparation, reception, and transmission. Messages can be corrected during preparation or may be recalled from the send buffer for editing at any time before transmission. Editing capabilities permit replacements, additions, or deletions of individual characters, words, or complete sentences. The controller operates in both point to point and message switched networks. **Anderson Jacobson, Inc,** 521 Charcot Ave, San Jose, CA 95131.

See at Booth 1147

Circle 603 on Inquiry Card

MAGNETIC TAPE CONTROLLERS



TC01 dual-density controller/formatter for the DEC LSI-11, -11/2, and -11/23 microcomputers provides complete compatibility with DEC TU10/TM11 tape subsystems. It provides software transparent operation for use with any industry std reel-to-reel magnetic tape drive at speeds to 75 in (190 cm)/s. Users may switch select data recording in either NRZ format at 200 to 800 bits/in (79 to 315 bits/cm) or in PE format at 1600 bits/in (630 bits/cm). Software transparent TC70 controller meets the high density GCR tape storage requirements of the PDP-11/70. It functionally emulates DEC's TM03/TU45 controller and tape drive. TC70/A supports Telex 6240/6250 tape transports; TC70/B supports STC 1921/1951/1953 tape transports. In either configuration, the controller will emulate both the DEC TWU45 and the TWU77 tape subsystems, recording at speeds up to 125 in (317 cm)/s and at densities of 800, 1600, or 6250 bits/in (315, 630, or 2460 bits/cm). **Emulex Corp,** 2001 E Deere Ave, Santa Ana, CA 92705

See at Booth 3415

Circle 604 on Inquiry Card

MINICOMPUTER SYSTEM FOR SOFTWARE DEVELOPMENT

Packaged version of the SCOUT™ Naked Mini® 4/04 computer is preconfigured to include minimum components required for OEM software development. Ease of ordering by one model number and assurance of availability of required components are major benefits of the preconfigured system. SCOUT realtime executive software (RTX) is included at no additional charge. The system, aimed at industrial control and communications applications, provides all interfaces and cables for direct connection to the software development system. It includes a CPU, 64k bytes of RAM, remote programmer's console with interface, 9-slot card cage with power supply, CRT serial I/O, modem serial I/O, CRT Pico-Processor™ controller, CRT/modem cable, optional instruction set, and RTX. **Computer Automation, Naked Mini Div,** 18651 Von Karman, Irvine, CA 92713.

See at Booth 3014

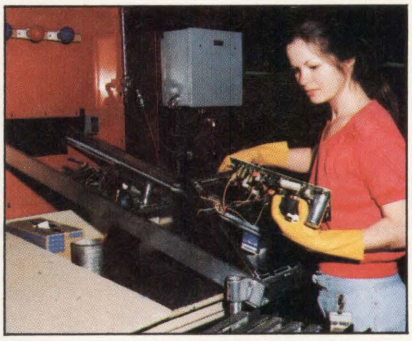
Circle 605 on Inquiry Card

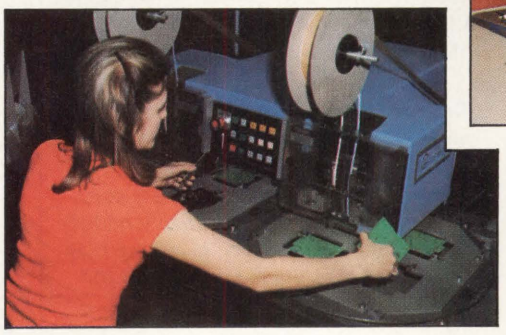
Motorola's unique multi-million dollar facility in Joplin . . .

NCC Booth 2234











a meaningful new factor in your CRT Display decisions.

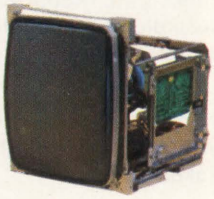
Make; buy; where to buy? If you are involved with CRT Display decisions, the new Motorola facility in Joplin, MO, is of vital interest to you. It houses the most inventive and exacting production and in-line testing equipment ever designed to achieve the ultimate in consistent quality conformance for CRT display systems.

Only Motorola can offer phase to phase quality control and verification throughout the total CRT Display manufacturing process.

Beginning with basic components manufacturing, the Joplin plant is equipped with the latest in programmed sequencing and automatic insertion. New production line techniques keep handling to a minimum as circuit panels move through assembly and self-soldering stations. Verified at every stage, the panels must then pass testing on Motorola's futuristic Video Display Analyzers. No faulty focus or resolution; no blemish; no linear or geometric flaw can escape detection. Finally, samples of every production run are subjected to long term extreme environmental testing.

The bottom line is consistent top quality and reliability at the right price. The Joplin plant represents a new state of the art in engineering and manufacturing fine CRT Displays. No terminal manufacturer could profitably match Motorola's productivity and the overall quality of its end product.

Motorola displays the character of your business.



MOTOROLA

Display Systems

1155 Harvester Road West Chicago, IL 60185
312/231-4400

CIRCLE 86 ON INQUIRY CARD

NCC PRODUCT REVIEW

Many companies exhibiting at NCC '80 are showing products that were announced previously or were described in recent issues of Computer Design; *still others supplied information that was too late or too little for processing as "first time shown" products. The following briefs are a sampling of the products that NCC '80 attendees can expect to be exhibited by some of those companies. In a few cases, a reference is provided to a longer description of a key product elsewhere in this issue.*

Anadex, Inc (Booth 1359): 80- and 96-col dot matrix printers

Ann Arbor Terminals, Inc (Booth 1247): ANSI X3.64-1979 specification terminal (The Graduate) equipped with CMOS battery RAM

Apple Computer Inc (Booth 536): See Micro Data Stack, p 214

Applied Magnetics, Magnetic Head Div (Booth 1411): 18-track and streamer tape heads, and double-density, double-sided floppy disc heads

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Beehive International (Booth 1227): See Communications Channel, p 28

Boschert Inc (Booth 2659): Switching power supplies including 3-terminal, 25-W, and 130-W types

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California Computer Products (Booth 2629): See Technology Review, p 68d

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Century Data Systems (Booth 4401): Trident, Hunter, Marksman, and Diablo disc drives

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Codex Corp (Booth 2341): Digi-phone™ voice digitizer and Info-guard™ data security system

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Compucorp (Booth 40): Model 675 desktop computer with up to 2.5M-byte diskette storage

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Dennison KYBE Corp (Booth 1404): Tape maintenance systems

Digi-Log Systems, Inc (Booth 1408): Digital data communications line monitor and diagnostic aid

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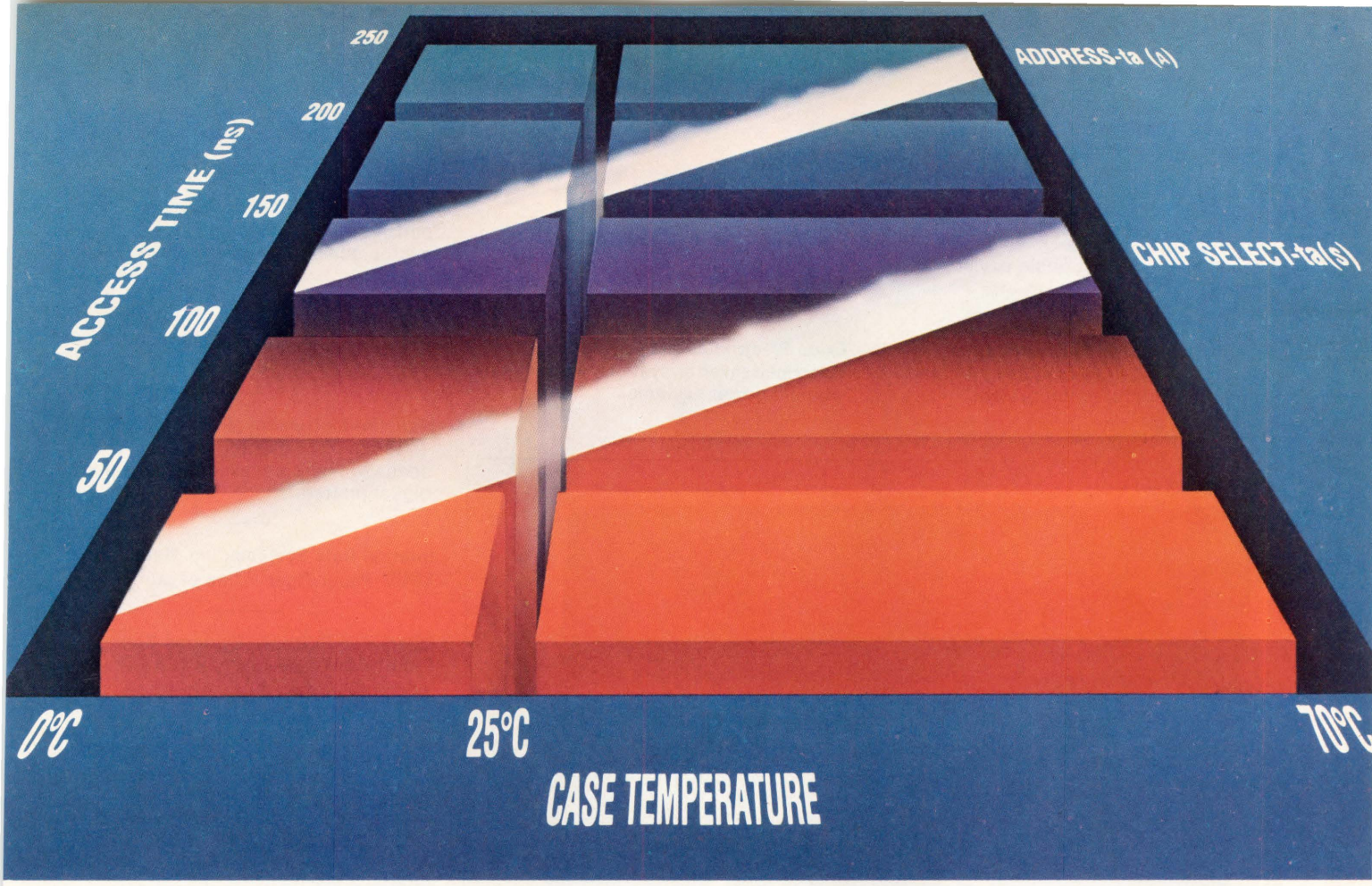
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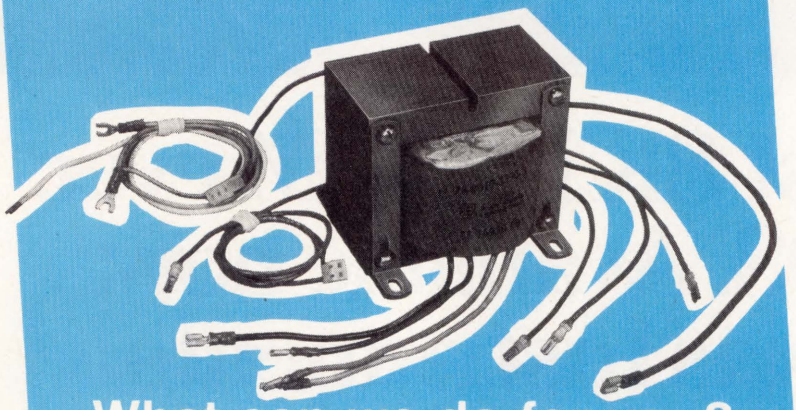
Emergency Power Engineering Inc (Booth 3308): Powerbloc 30-kVA computer power protection system

Epson America, Inc (Booth 2257): 80-and 132-col dot matrix printers for small business and home computers

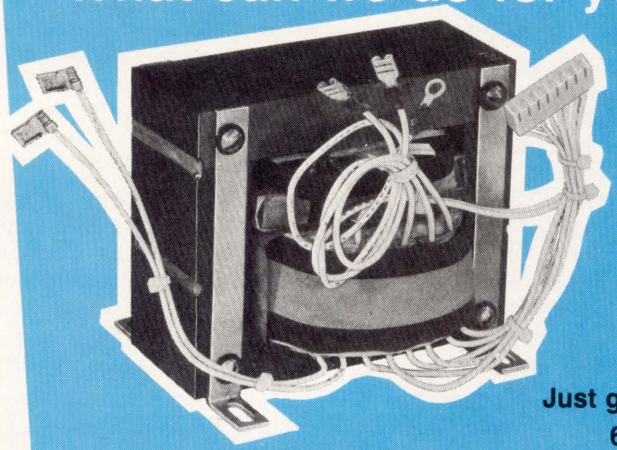
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GTE Sylvania Inc (Booth 4440): Long persistance phosphors and high resolution color data display tubes

Houston Instrument (Booth 1539): CPS 14/15 family of plotting systems, a series of microprocessor based 4-pen digital plotters

Integral Data Systems, Inc (Booth 2848): Paper Tiger™ line of printers

Integrated Software Systems Corp (Booth 1344): Dissplа and Tell-a-Graf computer software

Intel Commercial Systems Div (Booth 1354): Family of Information Resource Management products, including FAST-3805 Data Base Assist Processor

Interface Mechanisms, Inc (Booth 2517): Model 9300 bar code reader for 8 codes and 3 code combinations, with model 1236 Ruby Wand® lightpen

Interstate Electronics Corp (Booth 4027): Voice recognition modules and voice data entry systems

Intertec Data Systems Corp (Booth 2240): Video display terminal that emulates control codes of other terminals, video computer system, and 20M-byte Winchester type drive

Key Tronic Corp (Booth 2159): Bi/async interface, military keyboard, and fixed read head

Licon Div ITW (Booth 1627): Series 39 miniature and series 05 universal lighted pushbutton switches

Lynwood Scientific Developments Ltd (Booth 4102): Alpha 16-bit microprocessor controlled visual display terminal

Magnavox Display Systems (Booth 1450): Orion-60/S4 computer graphic system

Microdata Corp (Booth 3200): Reality series 8000 minicomputer systems with 512k-byte memory

NCC PRODUCT REVIEW

Micropolis Corp (Booth 1260): 5.25″ floppy drives, 8″ rigid disc S-100 subsystem, and 8″ Winchester drives

Monolithic Systems Corp (Booth 1743): See Product Feature, p 259

Nanodata Computer Corp (Booth 3015): QMX 6300 series of IBM plug compatible computers

Northern Telecom Systems Corp (Booth 2309): Model 290 online display system, and model 405 entry level distributed data processing system

North Star Computers Inc (Booth 131): HDS-18 18M-byte formatted hard disc system and application software packages

Panasonic Co (Booth 2234): CRT monitors, small business computers, and data entry terminal

Pericom Data Systems (Booth 4100): DEC VT-100 compatible visual display unit

Philips Test & Measuring Instruments, Inc (Booth 3222): 100-MHz PM3500 logic state and timing analyzer, PM3263 microprocessor based time measuring scope, and 25- and 35-MHz oscilloscopes

Plessey Microsystems Ltd (Booth 4007): Miproc 16M fully militarized microcomputer

Point 4 Data Corp (Booth 1846): Management, accounting, and control systems

Practical Automation, Inc (Booth 1254): 20- to 80-col matrix impact printers with serial or parallel input

Precision Handling Devices, Inc (Booth 1263): Form feed tractors for daisy wheel and Teletype model 43 type printers

Printronix, Inc (Booth 1312): Medium speed line matrix impact printers with 96- or 160-char ASCII sets

Rair Ltd (Booth 4106): 10/20M-byte hard disc Winchester drive

Rockwell Microelectronic Devices (Booth 157): AIM 65 personal computer

Shugart Technology (Registry Hotel): See Feature Product, p 262

Spatial Data Systems (Booth 1200): EyeCom II realtime image processing system and automated parts measurement system

TEAC Corp of America (Booth 2507): FD50A 35-track, FD50C 77-track, and FD58 5.25″ floppy disc drives

Techtran Industries, Inc (Booth 1353): Micro-Disc and Interactors™ digital data collection units

Tektronix, Inc (Booth 2327): See Feature Product, p 269

Teledyne Inet (Booth 2356): 75-kVA uninterruptible power supply system

Teletype Corp (Booth 1519): 4540 keyboard display based system, 4520 keyboard printer, and 43 buffered BSR tabletop teleprinter

Telex Computer Products (Booth 2553): Tri-density and 3420 compatible tape drives, display terminal/controller, interactive terminal, and tabletop printers

Texas Instruments Inc (Booth 1607): Silent 700™ 780 series and OMNI 800™ electronic data terminal, and model 820 RO printer

Time Utilising Business Systems Ltd (Booth 4013): Comprehensive computer system for less experienced users

Topaz Electronics Div (Booth 1243): 50-and 60-Hz power conditioners for minicomputers

Vector Graphic, Inc (Booth 4305): Z80 based Vector 3030 word and data processing system

Vu-data Corp (Booth 2141): 25-MHz DMM/frequency counter for field service

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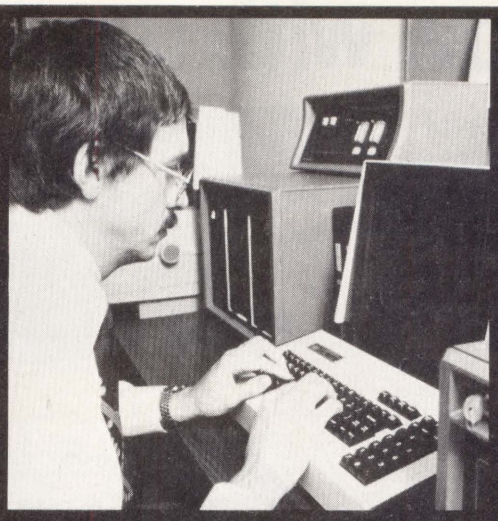
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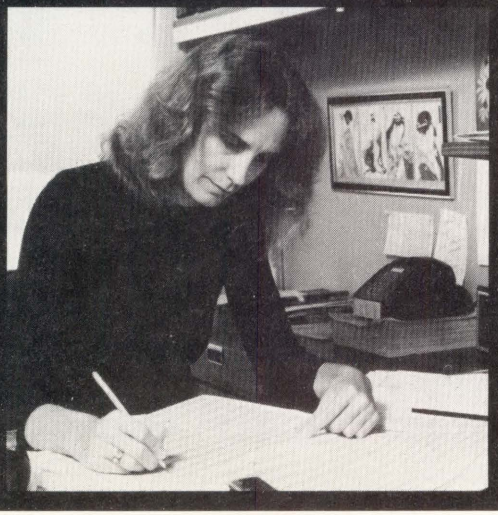
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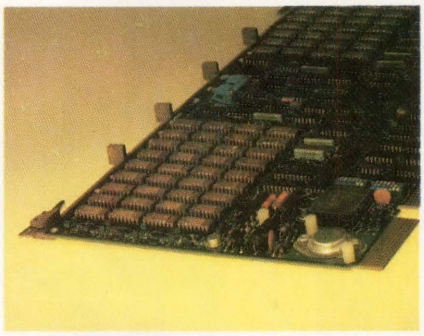
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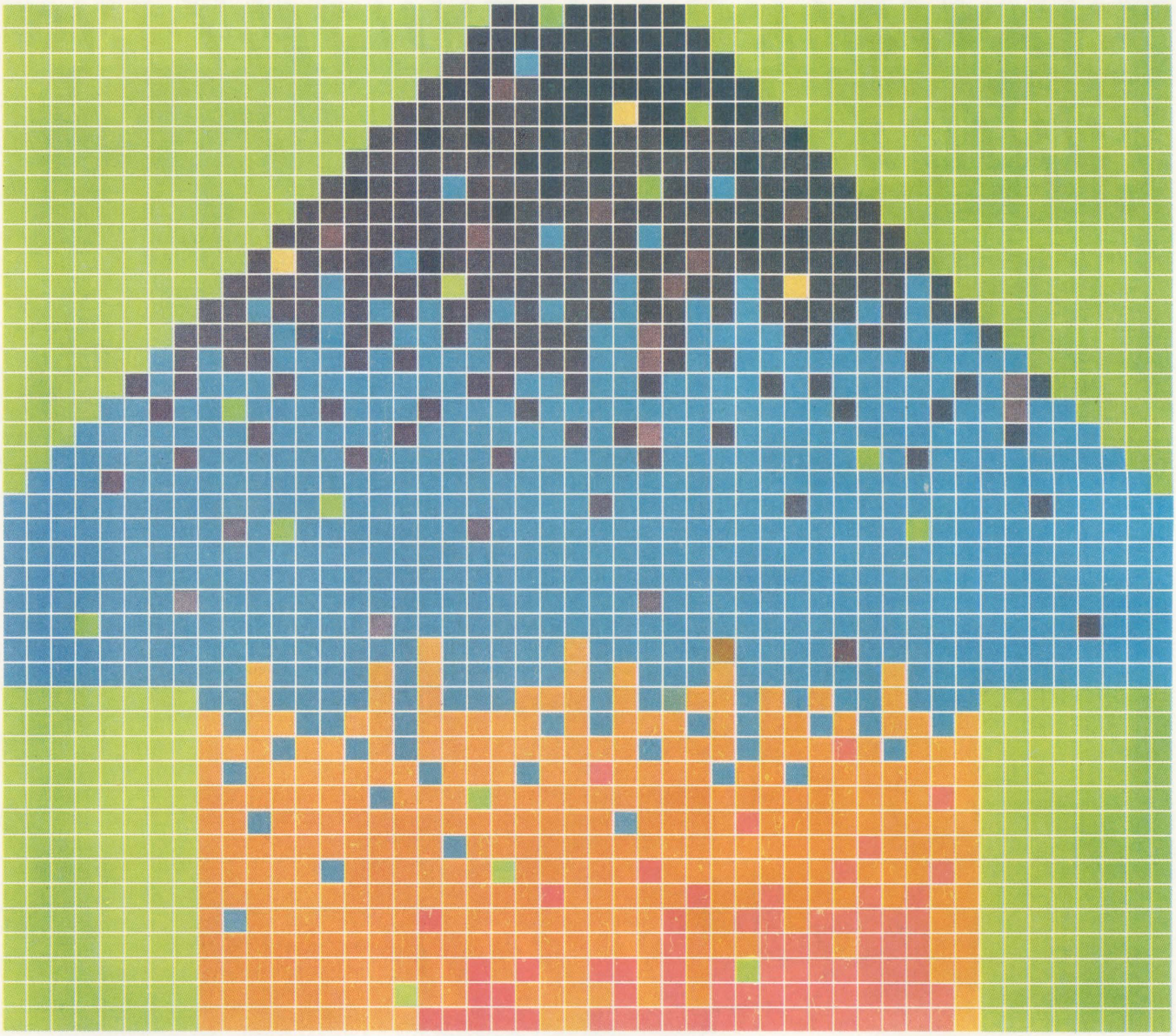
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A TOP-DOWN EVALUATION OF PASCAL

Top-down approach to Pascal presents structure and capability as a basis for evaluating the utility, according to the benefits and deficits, of this higher level programming language

Keith L. Doty University of Florida, Gainesville, Florida

In the mid-1960s, the computer community became acutely aware of software development costs. Project after project exceeded time and cost estimates. The blame, both then and now, can be laid on a number of factors: poor management, undisciplined program code, inadequate documentation, low programmer productivity, ignorance of program testing methodology, and so on. To combat software failure, a number of specialists in academia and industry began a serious assault on these problems. The result of one such effort is the programming language Pascal. This examination covers some of the more noticeable and powerful features of Pascal that make it a remarkably useful tool.

Pascal has received considerable attention in technical journals and trade magazines over the past few years. Amid claims that Pascal compiles and executes faster than FORTRAN or BASIC, the skeptical reader might want to know how this is possible. What is it about Pascal that draws such enthusiastic support? What does it mean that one programming language is more powerful than another?

Such questions run rampant and do not have simple answers. Pascal draws this support for several reasons. Its language features are systematically developed and logically consistent. Subjectively, this translates into: The language syntax and semantics usually mean what one expects them to mean. Numerous exceptions and default conditions have been avoided. Moreover, Pascal's unifying design philosophy focuses on supporting structured programming techniques and principles. Consequently, the language implements these concepts extremely well.

The second question concerning the powerfulness of a language is really too simply put. A series of races

may determine which of two horses is faster, but not necessarily which is the "better" horse. Determining the better horse, assuming "better" does not mean "faster," requires testable attributes with some measure of relative merit. Suddenly, the problem of evaluating the horses becomes complex. Determining testable attributes and relative merits with regard to the power of a programming language is no less difficult.

Although the discipline of software science deals with issues like these, benchmarking is usually performed on applications of interest to the end user (running a series of races) to obtain quantitative data. Since benchmarking may be expensive and narrowly directed, qualitative evaluations continue to play an important part in the overall assessment of a language. The objective of this article is to present the simple structure of Pascal programs, its data structuring capability, and some of the philosophy and history of its design, in order to form a knowledgeable basis for examination and exploration of Pascal's capabilities.

A special warning is necessary, here, for those acquainted with other languages, especially FORTRAN. A phenomenon, known as the "native language syndrome," interferes with the learning of a new programming language. Usually, the first programming language learned and used by an individual becomes the standard of comparison for all other programming languages. The problem, however, is that even poor features of the familiar language somehow tend to become a necessity. When a new language surfaces without such features, the programmer immediately jumps to the conclusion that the new language is inferior, or at least poorly conceived. Quick, subjective evaluations like this can be damaging to a truly fine, new language.

Another problem is also associated with the native language syndrome. A programmer's ability to easily code algorithms in his native programming language contrasts sharply with the frustration of coding with a foreign language. Modes of expression might be so completely different that the programmer finds the new language impossibly difficult to use. Old, familiar solutions and program design techniques simply might not work well in the new language. This immediately posts a barrier to even considering a new language, let alone learning to use it.

Besides subjective factors, there are economic barriers to the consideration or adoption of a new language. Capital and personnel investment in a particular language may be so extensive that changing to a new language would create a turnover transition time measured, perhaps, in decades—and at considerable expense. These are real problems, and any language that proposes to replace or, at least, stand beside FORTRAN as the common language of programming had better have a lot to offer. Many believe that Pascal can meet that challenge.

History Of Pascal

In 1965, Professor Niklaus Wirth at Eidgenössische Technische Hochschule in Zürich, Switzerland, proposed a successor language to ALGOL 60 that would encourage and facilitate the teaching and practice of systematic programming, compile quickly and reliably, and extend the utility of ALGOL 60 beyond algebraic and numerical computations. His suggestions met with limited support from the technical community. In 1968 Professor Wirth continued the development of a language using ALGOL 60 as a basis. Wirth named the language Pascal in honor of the 17th century philosopher and mathematician Blaise Pascal.

The first operational Pascal compiler, written in FORTRAN for a CDC 6000 machine, proved unsatisfactory and was scratched. A second compiler, written in Pascal itself, became available in 1970. Pascal was officially announced in 1971 by Wirth.[1,2] An obvious question is what good is a Pascal compiler written in Pascal? Without a Pascal compiler, one cannot compile the compiler. Fig 1 shows a bootstrapping technique that eliminates the problem. Several points about the process in Fig 1

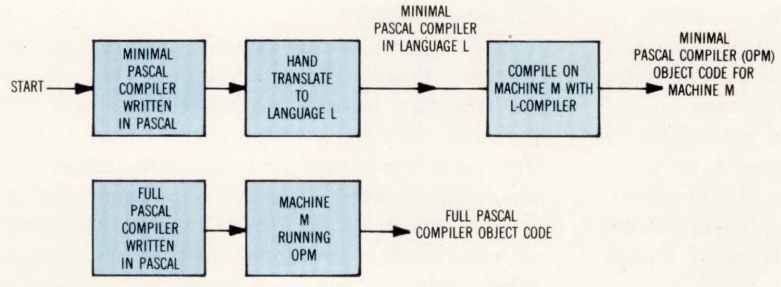


Fig 1 Compiler bootstrapping technique. Minimal compiler, written in Pascal and capable of compiling itself into object code, is hand translated to language L for which a compiler exists on machine M. L-language version of hand translation is compiled to produce object code on machine M. This is then run on machine M to create object code for full Pascal compiler

should be emphasized. First, the minimal Pascal compiler must be complete. In other words, any Pascal language facility must be expressible as a Pascal program that the minimal compiler can compile. Second, the object code generated by the compiler need not be the same as that of the host machine M. Finally, the quality of the full compiler object code depends upon the quality of the code generated by the minimal Pascal compiler, written in Pascal, and not upon the L-compiled hand translation.

A formal, axiomatic definition of Pascal, developed by C. A. R. Hoare and Wirth in 1972, suggested several changes to Pascal's syntax. A revised compiler and report were subsequently generated late in 1972, and a user's manual was published in 1973.[3] Since 1973, Pascal's distribution has expanded considerably. Initially, Wirth's group in Switzerland informally handled distribution and problems with the compiler. As wider usage developed, principally in academia, a number of dialects began to appear and other distribution mechanisms arose. Of particular interest, Kenneth Bowles at the University of California, San Diego (UCSD), developed a Pascal compiler for microcomputers. The UCSD effort began in 1974 and has generated considerable interest in the microcomputer field. Largely because of recent popular demand for the UCSD Pascal, most microcomputer manufacturers support or plan to support Pascal. In fact, the UCSD compiler has itself gone commercial.

Structure Of Pascal Programs

Upon the first encounter with a new programming language, a programmer should insist on seeing a typical program structure in that language—a top-down view. From such a description, the programmer can make language comparisons, noting similarities and differences, without contending with syntactic detail. As study progresses to finer points in the language, the initial framework fleshes out to a more complete model, providing a solid structure that enhances understanding.

Fig 2 illustrates the overall structure of a Pascal program. Programs, procedures, and functions all begin with a heading declaring what program structure is being defined. Following the heading, each of these code structures has an identical syntactic template called a <block>. Each <block> is partitioned into two major substructures. One defines the data, and the other contains the executable statements. Consequently, procedures and functions may nest to any level of definition. Designating the program by level zero would define procedures and functions in the data portion at level 1.

```
{(1) program heading}
program <identifier>(input, output, <file list>) ;
{(2) data definition and declaration part}
label <unsigned integer> ; {statement labels}
const <identifier> = <constant> ; {symbolic naming of constants}
type <identifier> = <type> ; {user defined data types}
var <identifier> : <type> ; {variable declarations}
procedure <identifier>(<parameters>) ;
        <block>
function <identifier>(<parameters>) : <result type> ;
        <block>
{(3) compound statement, executable part}
begin <statement> ; ...; <statement> ;
      <statement> ; ...; <statement> ;
            .
            .
            .
      <statement> ; ...; <statement>
end. {end of program}
```

Fig 2 A Pascal program consists of three parts. Nonexecutable program heading (1) is followed by data definition portion (2). Executable program statements (3) follow data definition part and manipulate defined data. Syntactic variable <block> consists of data definition part (2) and executable statements (3)

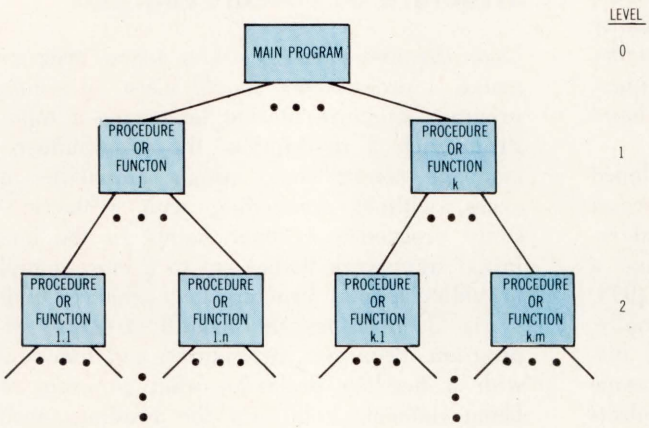


Fig 3 Lexical structure of Pascal program defines hierarchy of code blocks. Left to right ordering of procedures or functions in any level reflects their order of appearance in data part of that level's defining block. This may be significant since procedures and functions must be defined before being used

Procedures and functions defined within the data portion of level 1 occupy level 2, and so on. Fig 3 shows the levels of a Pascal program.

Scope Of A Variable

An important function of language syntax is to define unambiguously the scope, or range of validity, of an identifier. A particular definition of a Pascal identifier, x, is valid only within the defining block, D. Further, this definition will be subsumed by any definitions of x in lower level blocks within D. The identifier x is said to be "local" to D and "global" to lower level blocks in D where the definition of x is not subsumed. A definition of x in the main program will be global to all procedures unless redefined (Fig 3). If procedure 1 should redefine x or introduce a new identifier, y, the scope of y and the redefined x span the hierarchy rooted at procedure 1, unless these definitions, too, are subsumed.

Consider the nonsense program in Fig 4 consisting of three blocks—the program, MAIN, and two functions, SILLY and VALUE. The block structure is diagrammed in Fig 5, which explains the scopes of the various identifiers. An alternative method for describing the structure of this program is shown in Fig 6. Both illustrate Pascal as a block structured language.

Sample Pascal Programs

Continuing with a top-down description of Pascal, the example in Fig 7 does not illustrate anything peculiar to Pascal; other languages can achieve the same results as easily. Rather, it provides a deeper understanding of the structure of Pascal programs.

```
program main(input, output) ;
var x, y, z : integer ; w : real ;
function silly (j, k : integer) : real ;
  const x = 2.5 ; t = 3.5 ;
  function value : integer ;
    var y : char ;
    begin readln(y) ; writeln(y) ;
          value := ord(y)
    end ; {value}
  begin
      silly := x*j + t*k + value ;
   z := z + 1 {a side-effect.poor programming}
  end ; {silly}
begin x := 0 ; y := 1 ; z := 2 ;
      w := silly (y, z)
end. {main}
```

Fig 4 Scope of variable definitions. In this nonsense program, scope of identifier z is global to functions SILLY and VALUE. Identifier x is redefined in SILLY, so it is local to SILLY and global to VALUE. Identifier y is redefined in VALUE and is local there

Compare the structure of the HARMONIC program (Fig 7) with the general structure of a Pascal program shown in Fig 2. HARMONIC, a simple program, uses only ***var*** in the data part. This shows that not all components of the data portion need to be present in a program. Only those data constructs actually needed are employed. However, the components used must take place in the strict ordering delimited by their occurrence in the defining structure of Fig 2. For example, ***const*** definitions must always occur before ***var*** declarations when the two appear together.

Whereas the data portion has optional constructs, the compound statement section of the program must always start with the reserved word ***begin*** and terminate with the reserved word ***end*** followed by a period. In this article, all reserved words are denoted by boldface type.

output. The *input* file is accessed by the standard procedure *read*, and the *output* file is written into by procedure *write*. For our purposes, the *input* file consists of keystrokes from a terminal, and the *output* file is a visual display unit.

Pascal Data Types

After the program heading and the comments describing the program's function, the data declaration ***var*** identifies two integer variables, *i* and *n*, and a real variable, *h*. Every variable in a Pascal program must be declared with an associated type that remains unchanged throughout the program. Consequently, Pascal is often called a strongly typed language.

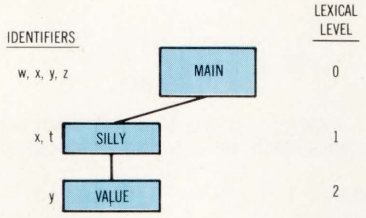


Fig 5 Hierarchical structure analysis determines scope of identifiers. Definitions of *w* and *z* in MAIN are valid in SILLY and VALUE, whereas definition of *x* is subsumed in SILLY and definition of *y* in VALUE. This means *x* in SILLY is global to VALUE and *y* in MAIN is global to SILLY, but not to VALUE. New variable *t* is local to SILLY and global to VALUE

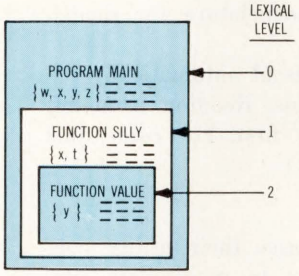


Fig 6 Block structure of Pascal program. Structure can be outlined by contour that defines scope of each block's local variables

Comments surrounded by braces {*comment*} may appear anywhere in the program. They help to explain the programmer's intent and document the program function. A program as simple as HARMONIC does not require much commenting; even the comment {*initialize h*} is superfluous. Perhaps a caution is necessary here. Comments should be thought out carefully and used judiciously. For example,

$x := x + 1$ {*increase x by one*}

is verbose and uninformative.

The first element of the program text to be examined is the program heading that specifies a program named HARMONIC with two standard file parameters, *input* and

In addition to the standard data types—real, integer, char (character), and Boolean—Pascal supports a variety of structured data types—array, record, file, and set, as well as a special type, pointer (Fig 8). Pascal also provides the facility for the programmer to finitely enumerate the domain of values taken by a variable or to define a new type. For example,

var *color* : (*red, blue, green, yellow*) ;

declares a variable, *color*, whose values must be one of the four colors listed. If a programmer uses several variables of a nonstandard type, he can define his own type and then declare each of those variables as elements of that type

```
program harmonic(input, output) ;
  {compute the harmonic series}
  {h(n) = 1 + ½ + ⅓ + ... + 1/n}
var i, n : integer ; h : real ;
begin read(n) ; write(n) ;
  h := 0 ; {initialize h}
  for i:= n down to 1 do h = h + 1/i ;
  writeln(h)
end. {harmonic}
```

Fig 7 Iteration control. Program uses ***for*** statement to loop through computation, in this case summing terms in harmonic series

type *hue* = (*red, blue, green, yellow*) ;
var *color, light* : *hue* ;

Both variables *color* and *light* are now typed *hue*. Typing is not restricted to enumerated types. A programmer may type any legal Pascal data definition. The power of Pascal's data typing mechanism leads to efficient data definitions and a meaningful nomenclature for modeling data.

Enumerating a data type in Pascal automatically defines a linear order of the elements. Reading from left to right, the minimum element is first. For *color*, this means that

red < *blue* < *green* < *yellow*

Ordering enumerated types increases their utility considerably, permitting programmers to manipulate enumerated type variables with the relational operators and three standard functions:

(1) *ord* (*x*) Ordinal value of *x* in the enumeration of its type

(2) *succ* (*x*) Successor value of *x* in the enumeration of its type

(3) *pred* (*x*) Predecessor value of *x* in the enumeration of its type

Using the variable *color*, Table 1 displays some computations using ord, succ, and pred on the user defined type *hue*.

Pascal Statements

The most fundamental statement in a programming language is the assignment. An assignment statement associates a computed value with a variable. The assignment

color := *green*

forces the variable *color* to take on the value of *green* when executed. Any Pascal value of type T can be assigned to a variable of type T.

TABLE 1

Computations Using Ordinal (ord), Successor (succ), and Predecessor (pred)

ord(red) = 0	*pred(red)* = undefined
ord(blue) = 1	*pred(blue)* = *red*
ord(green) = 2	*pred(green)* = *blue*
ord(yellow) = 3	*pred(yellow)* = *green*
succ(red) = *blue*	*succ(pred(blue))* = *blue*
succ(blue) = *green*	*pred(succ(blue))* = *blue*
succ(green) = *yellow*	*succ(succ(red))* = *green*
succ(yellow) = undefined	*pred(pred(green))* = *red*

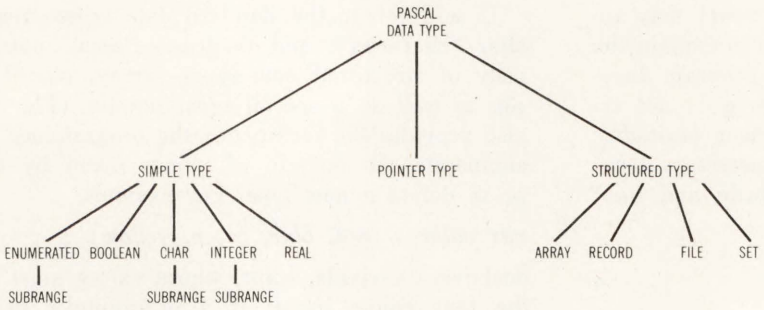


Fig 8 Pascal data types. Generalized notion includes structured data elements as well as simple types. Enumerated type permits programmers to define any finite domain for a variable

After the data definition and declaration part of a program, procedure, or function comes the compound statement containing the executable statements. The number of statements between the ***begin*** and ***end*** delimiters of a compound statement is not bounded. Each instance of a statement, however, is limited to one of the ten possible kinds that Pascal supports. Table 2 lists all the Pascal statement structures.

TABLE 2

Pascal Statements

	Statement Class	Example
(1)	Assignment	`h := 0`
(2)	Procedure	`read(n)`
(3)	Compound	`begin x := 4 ; y := 3*x end`
(4)	Selection	
	if	`if color ≠ yellow then color := succ(color)`
	case	`case color of red : x := y + 12 ; blue: color := pred(hue) ; green : ; yellow : hue := green end`
	goto	`goto 235`
(5)	Iteration	
	for	`for i := 1 to 15 do x := x + 1 ;`
	while	`while x > 0 do x := x − 1 ;`
	repeat	`repeat x := x + 1 until x ≥ 1000`
(6)	With	`with recordtype do sex := male`

Use of the semicolon in Pascal deserves mention. If the data definitions ***label***, ***const***, ***type***, ***var***, ***procedure***, and ***function***, along with ***program***, ***procedure***, and ***function*** headings, are considered to be statements, Pascal employs the semicolon as a statement separator and not a terminator. For example, in Fig 7, the last statement, *writeln(h)*, is not followed by a semicolon, since the next program entity, "**end.**," is not the beginning of another statement. On the other hand, the ***var*** declaration ends in a semicolon since the following entity, "***begin***," initiates another statement. Finally, note that multiple entries in a data definition are also separated by semicolons, the notion being that each entry is a distinct declarative statement.

The HARMONIC program in Fig 7 incorporates four of the six statement classes: compound, procedure, assignment, and iteration. Compound and assignment statements have already been covered; focus will now be on the remaining two. The procedure statements *read(n)*, *write(n)*, and *writeln(n)* invoke the named procedure as a subroutine call. Upon exit from the invoked procedure, program control passes to the following statement. The iteration statement in HARMONIC, characterized by the reserved word ***for***, is one of the three possible Pascal loop control mechanisms. The statement

$h := h + 1/i$

following the ***do*** is executed n times. The initial value of i is n. After each execution of the above statement, the value of i is decremented. If the resulting value is less than 1, the ***for*** statement releases control and the next sequential statement executes.

Pascal and Structured Programming

Pascal was designed to encourage structured programming. The conditional selectors ***if*** and ***case***, along with the three iteration statements ***for***, ***while***, and ***repeat***, implement the usual structured program control mechanisms directly. Flowcharts for the ***if***, ***while***, and ***repeat*** constructs are shown in Fig 9(a), (b), and (c). The ***for*** and ***case*** statements are not shown, because they are special, important variations of the ***while*** and ***if*** statements, respectively.

The presence of the unconditional selector ***goto*** in Pascal has a rightful place in programming practice, even though it is easily abused. There are a few instances where the application of a ***goto*** statement clarifies and simplifies a program. Aborting an input routine that detects invalid data is one such instance. A disciplined use of the ***goto*** by a programmer experienced with structured coding should not cause problems.

To avoid misinterpretation, however, it should be emphasized that most Pascal programs will be better written if the ***goto*** is forgotten altogether. Pascal's other control statements easily satisfy typical program requirements. FORTRAN programmers find this especially difficult to believe at first. If forced to write Pascal code without using the ***goto***, they often complain hostilely. If they allow themselves enough time and experience to adjust, their attitude usually changes.

Structured Data Types

Pascal not only has a good selection of primitive data structures (arrays, records, sets, and files) but also allows these structures to be nested. An array of records, for example, would be a legitimate Pascal data structure. This rich structuring mechanism tends to make Pascal programming simpler. Programmers do not have to map the problem environment into the highly restricted forms demanded by most other languages. To gain a better understanding of Pascal data structures and their application, consider a few examples of each.

Arrays and Records

Pascal array variables can be defined to appear straightforward,

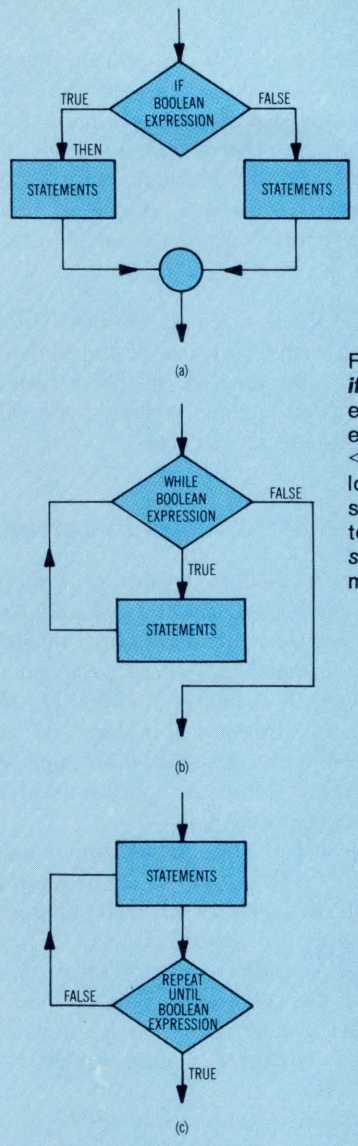


Fig 9 Control constructs and variations. Conditional, or 2-way selector ***if*** *<expression>* ***then*** *<statement>* ***else*** *<statement>*, in (a) have one entry and one exit. Statements following ***then*** execute if expression evaluates true; otherwise, ***else*** statements execute. Construct, ***while*** *<expression>* ***do*** *<statement>*, forces repeated execution of iteration loop until expression evaluates false (b). More efficient ***for*** construct should be used when number of iterations is known in advance. Post-test of looping condition is forced by ***repeat*** *<statement>* ***until*** *<expression>*, in contrast to pre-test forced by ***while*** construction (c). Statements in ***repeat-until*** construct must execute at least once

var *matrix* : ***array*** [*1..5, 1..3*] ***of*** *integer* ;

or rather unusual,

var *staff* : ***array*** [*1..100*] ***of*** *person* ;

where *person* is a programmer defined type,

type *person* = ***record***
name : ***array*** [*1..10*] ***of*** *char* :
rank : (*captain, major, colonel*)
end :

Each entry in the array *staff* is a 2-component record. The first component holds a 10-character name, and the second holds the rank of an individual on the staff.

The following program fragment creates one record of type *person* and stores it in the array. Assume "***var*** *me* : *person* ;" has been declared.

me.name := *'Keith Doty'* ;
me.rank := *colonel* ;
staff [*25*] := *me*

Observe that record component labels serve as name qualifiers to address a desired entry while arrays are indexed. Accessing a name requires knowing the array index to get the *person* record, and the record *name* qualifier to specify the first component,

me.name = *array* [*25*].*name*

Files

A file can be viewed as a sequence of identically typed components chained together. Chaining, or concatenating, a new element into the file must take place at the end. The length of a file equals the number of elements chained together and is not fixed, as are the sizes of arrays and records. An element of a file is accessed through a so-called window, defined by a cursor pointing to the element. Several standard Pascal procedures also support file accessing.

Two files of great interest, *input* and *output*, belong to the special class of text files

type *text* = ***file of*** *char* ;

Standard Pascal requires that *input* and *output* be listed in the parameter section of a program heading. Unlike other files listed there, *input* and *output* must not be defined within the program. They both have peculiar properties and are maintained by the system.

The standard functions *read(x)* and *readln(x)* implicitly refer to the *input* file. Variable *x* must be of

type character, integer, or real. The action invoked by these procedures assigns the current window element to x and moves the cursor to the next element in the file. *Readln(x)* stands for "read line" and induces the additional action of moving the cursor to the next line of the input file.

Write(x) and *writeln(x)* implicitly refer to the *output* file. Variable x must be of type boolean, character, integer, real, string constant (a sequence of characters enclosed in quotes: 'This is a string constant'), or an expression producing such types. The programmer also has the option, as in FORTRAN, to specify the field widths for printing x. The *writeln* function will terminate the output with special line separator characters such as carriage return and line feed.

Some peculiar features of the *input* and *output* files are alluded to in the above discussion: Their components may have different types, and they support a substructure, called lines, delimited by line separators. The latter feature is shared by all Pascal text files.

A Complex File Example

Suppose that a number of installations around the country have personnel files similar to the previously described *staff* file, and that we want to maintain a central file on all of these. Since new installations are constantly being created, we select the Pascal ***file*** structure to form the basis of our data base. A large ***array*** would also work if its declared size exceeds the expected growth in the number of installations. The central file, *personnel*, could be declared as follows:

```
var personnel : file of installations ;
```

where

```
type installations = array [1..100] of persons ;
```

and *persons* is the record structure defined earlier. Nesting of Pascal data structures is quite evident here. The structure *personnel* is a file of individual, 100-element arrays whose entries are 2-component records. The first record component is itself a structure—a 10-element array.

Sets

In defining a set type, such as

```
type primary = set of (red, blue, green) ;
```

the programmer enumerates the universal set. If ***type*** *hue*, discussed earlier, were known, the subrange *red.. green* could also be used to define *primary*

```
type primary = set of red..green ;
```

Any subset of the universal set, say [*red, green*], is delimited by square brackets and may then be assigned to a variable of the set type. For example, if

```
var x : primary ;
```

then

```
x := [red]
```

means x is assigned the value [*red*], a subset of [*red, blue, green*]. Although sets may be constituents of larger structures, they themselves must have only elements of simple type.

Pointers

Arbitrary data structures can be created in Pascal using pointers. Pointer values designate the storage address of particular variables or structures and provide programmers with the means to connect such items together. A pointer must be bound to, or strictly identified with, a particular data type, however, and can designate only the address of variables having that specific type. For example, *link*, the pointer defined below, is bound to the data type *person* defined earlier.

```
type link = ↑ person ;
```

The arrow in the type definition designates that *link* is a pointer. Defining the pointer variable p of type *link*,

```
var p : link ;
```

then p can point only to variables of type *person*.

In order to create structures, we must define data types, T, which themselves contain pointers bound to T.

```
type iptr = ↑ item ;
     item = record
              num : integer ;
              quant : integer ;
              next : iptr
            end ;
```

The following program fragment will now connect n *item* records in a chain, schematically represented in Fig 10, and will initialize all values of *num* and *quant* to zero.

```
var first, pointer : iptr ; i : integer ;
    begin := nil ;
    for i := 1 to n do
        begin new (pointer) ;
              pointer↑.num := 0 ;
              pointer↑.quant := 0 ;
              pointer↑.next := first ;
                  first := pointer
    end.
```

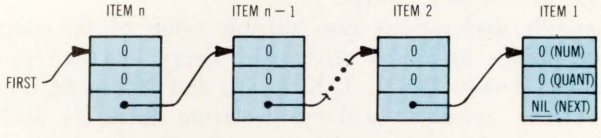


Fig 10 Linked data structures using pointer type. Identical records are chained together by pointers indicated with arrows. Each pointer addresses next element in chain

Introduced into this program fragment are several conventions which require explanation. The ***nil*** pointer does not point to or address anything; instead, it indicates the end of the chain [Fig 9(b)]. The standard Pascal function *new* creates new *item* records. This function allocates storage for a variable of the type bound to the pointer. The pointer itself furnishes the address of the newly created variable, which is identified by the nomenclature $p\uparrow$. In other words, $p\uparrow$ means "the variable pointed to by p." The storage allocated for $p\uparrow$ survives until the end of the program or until deallocated by the standard function *dispose*(p).

In the previous fragment,

pointer↑*.num*

refers to the *num* field of the newly allocated *item* variable created by ***new*** (*pointer*). Hence, after setting the *num* and *quant* fields to zero, the pointer field *next* is assigned the address of the previously created item (***nil*** the first time) and the chain grows by one element. After the n successive executions dictated by the ***for*** statement, the structure in Fig 9(b) results. Observe that *first* holds the address of the last *item* appended to the chain.

Features Lacking In Pascal

Pascal is a remarkably well designed language. Most criticisms of it suggest minor improvements or lament design choices leaving out favorite, perhaps significant, features: exponentiation and string operators, default declarations, mixed arithmetic, dynamic arrays, operator definitions, bit processing, and device input/output. Extension of Pascal to include some of these features violates the intent of Pascal's design, whereas extension to include others would not.

This does not imply that Pascal cannot be improved without compromising its design. Providing a mechanism to initialize data in the declaration part of a program eliminates potentially long, obscure passages of data assignment code and would improve the readability of Pascal programs. Allowing random access into files, rather than forcing sequential access as is currently required, would facilitate more efficient file processing.

Mixed mode arithmetic, although permitted in Pascal to the extent that integer types can combine with real types to create real types, introduces programmer confusion and often unexpected results. Consequently, languages that allow mixed arithmetic potentially invite subtle programing errors.

Default declarations also exhibit some of the same shortcomings as mixed arithmetic. Every FORTRAN programmer knows that I, J, K, L, M, and N can be used as integer variables without declaring them as such. This can lead to some unhappy results if a programmer attempts to assign a real value to an undeclared, default integer variable. Perhaps an accomplished FORTRAN programmer would ridicule such coding and minimize the problem here. Nonetheless, problems associated with default declarations can lead to programming errors easily avoided by eliminating that feature. The penalty, of course, is that every variable must be explicitly declared.

Exponentiation

Pascal does not provide an exponentiation operator by design. Studies analyzing the usage of exponentiation in FORTRAN have revealed that the most general case, X^Y = X**Y, X and Y real numbers, is seldom used. The most common usage found was X**2.0. Since a compiler might compute

X**2.0 = EXP(2.0*LN(x))

instead of the much more efficient

X** 2.0 = X*X

the designers decided to force Pascal programmers to consider their use of exponentiation explicitly. The standard Pascal functions $exp(z) = e^z$ and $ln(z) = log_e(z)$ allow the programmer to express

x**y = *exp*(*y***ln*(*x*))

if that, in fact, is what is required. The complexity of this expression, however, overtly prompts programmers to view the cost of such computations.

The highly efficient, standard Pascal function $sqr(x)$ for squaring a real number x is sufficient for generating small integral powers of x. For example, to compute x^{13}, then

$y := sqr(x)$; {$y = x^2$}
$w := sqr(y)$; {$w = x^4$}
$z := sqr\ (w)$; {$z = x^8$}
$t := x*w*z$; {$t = x^{13}$}

computes faster than

$t := exp(13*ln(x))$

although the former is certainly messier and less readable. Both methods, however, hide the essential fact that the programmer simply wants to calculate X**13. Defining a function to compute x^n

function *power* (*x* : *real* ; *n* : *integer*) : *real* ;

helps, but some may find it disturbing to see a polynominal $x^3 + 5x^2 + x + 1$ written

power(*x*, 3) + 5**power*(*x*, 2) + *x* = *1*

instead of the more familiar

X**3 + 5*X**2 + X + 1

Dynamic Arrays

Suppose a programmer were to write a Pascal procedure to add two matrices

procedure *addmat* (***var*** *x*, *y*, *z* : *matrix*) ;

where

type *matrix* = ***array*** [*1..8*, *1..10*] ***of*** *integer* ;

Although procedure *addmat* could be written in FORTRAN or BASIC to accommodate different size matrices, the

Pascal version is tightly bound to 8 x 10 matrices. A separate procedure must be written for each choice of index range utilized by the main program. In other words, standard Pascal does not support dynamic arrays.

The concept of functional programming clashes with the Pascal design philosophy. In functional programming, an operator demands only conformability of its argument data types, and not a strict, static binding to a particular argument type. The APL expression

A ← B + C

applies equally well to the sum of two scalars, vectors, or multidimensional arrays and is not bound to any particular choice until execution. The particular type of B and C at execution solely determines the type of A and the meaning of the + operator. This contrasts radically with the static binding of Pascal. The assignment

a := *b* + *c*

where

var *a, b, c* : *integer* ;

can mean only one thing. No matter what else is done in the program, the above expression, whenever executed, adds two integers, *b* and *c*, and assigns the result to the integer *a*. This is normally an extremely desirable property and has been intentionally incorporated within Pascal.

To include dynamic arrays within Pascal, therefore, violates some of the basic tenets of its design philosophy; however, the utility of dynamic arrays deserves consideration. Many feel that the standard language will be insignificantly compromised and extended to include dynamic arrays. The clarity and readability of Pascal programs would not be compromised.

Enhancement To Pascal

No language can simultaneously meet all possible linguistic or semantic requirements. This observation partially explains why so many voluntarily step forward to criticize a programimng language and offer fixes that make it nearly perfect. Many programmers who like Pascal and find it extremely powerful cannot resist adding their own suggestions. One chief criticism of Pascal is that it allows the programmer to define data types (good) without providing the facility to define operators on the data types (bad). For example, in the data definition part, operators might be defined as functions:

operator *opsymbol* (*left argument* : *type*,
    right argument : *type*) : *result type* ;
<block>

but be used lexically like standard operators,

a := *b* "opsymbol" *c*

Although the idea of extending Pascal operators introduces a few surmountable problems, such as determining the defined operator's precedence with respect to the standard operators, the concept is compatible with the notion of programmer defined types and opens the door to programmer defined algebras on those types.

A related secondary issue is the lack of textfile input and output capability with programmer defined data types. If the variable *color* has been assigned the value *red*, the statement

write(*color*),

while making good semantic sense, will not work. The token *red* is not the character string "r e d." Similarly,

read(*color*)

will not assign the token *red* to *color* if the string "r e d" is encountered as input. Changing the *read* routine to scan for and recognize a token in a text string is only slightly more difficult than detecting a digit string comprising a number. A currently proposed standard would actually require this capability.

Summary

Pascal is a block structured programming language with a rich variety of program control statements and data structuring mechanisms that assist in systematic program design and code development. The language is strongly typed, forcing the programmer to be precise in the definition of data. Strong typing also permits extensive compile time checks. As can be expected, there are some minor deficiencies and possible enhancements to Pascal. In particular, textfile input/output for user data types and a facility for defining operators on user data types should be provided by the language.

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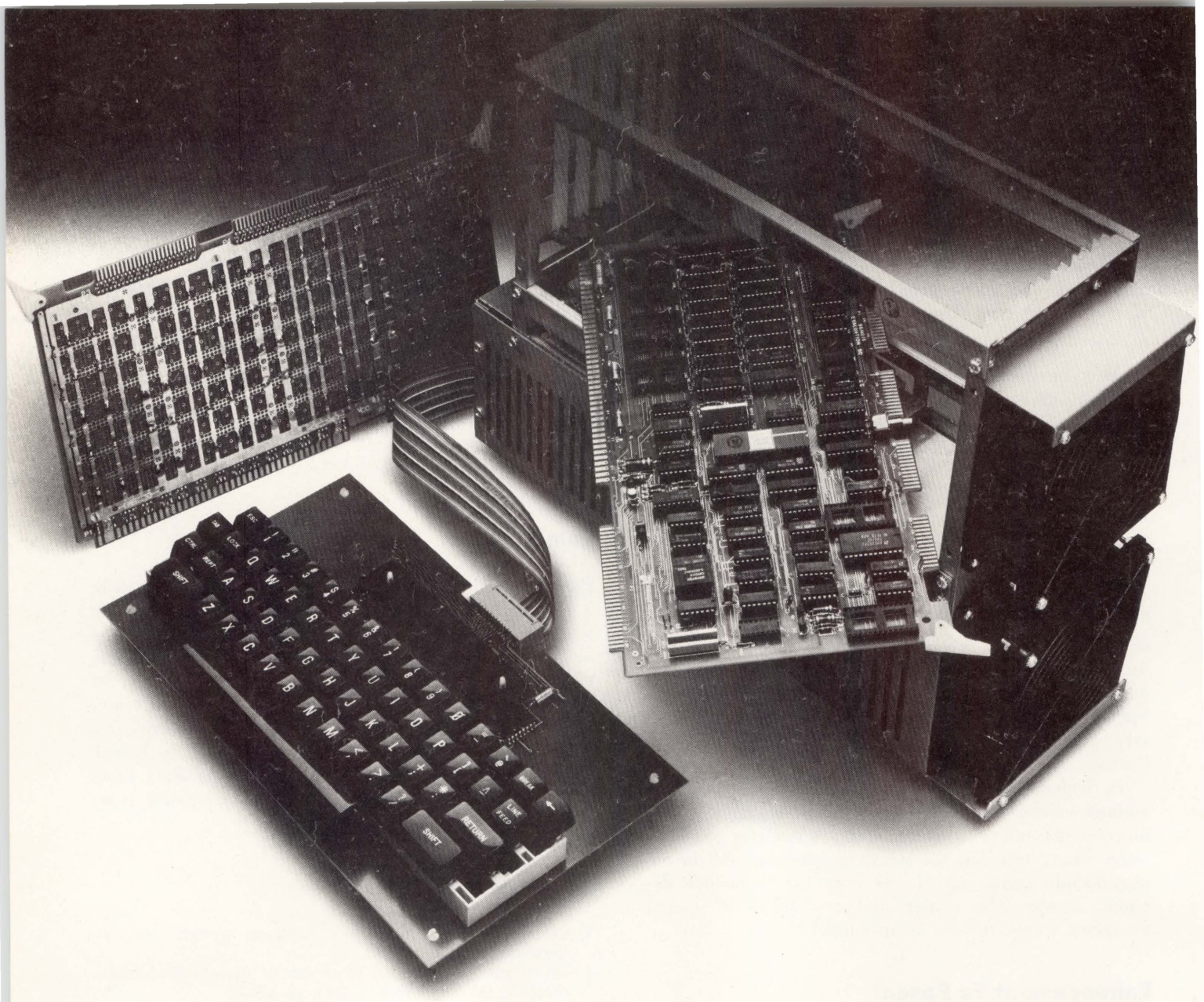
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As Associate Director at the University of Florida's Center for Intelligent Machines and Robotics (CIMAR), Keith Doty is investigating distributed microcomputer networks for mechanical robotic manipulators and database management systems. His expertise centers around minicomputer and microprocessor system design. He earned BSEE and MSEE degrees at MIT and a PhD at the University of California, Berkeley.



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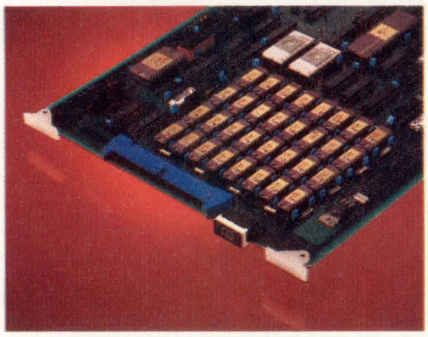
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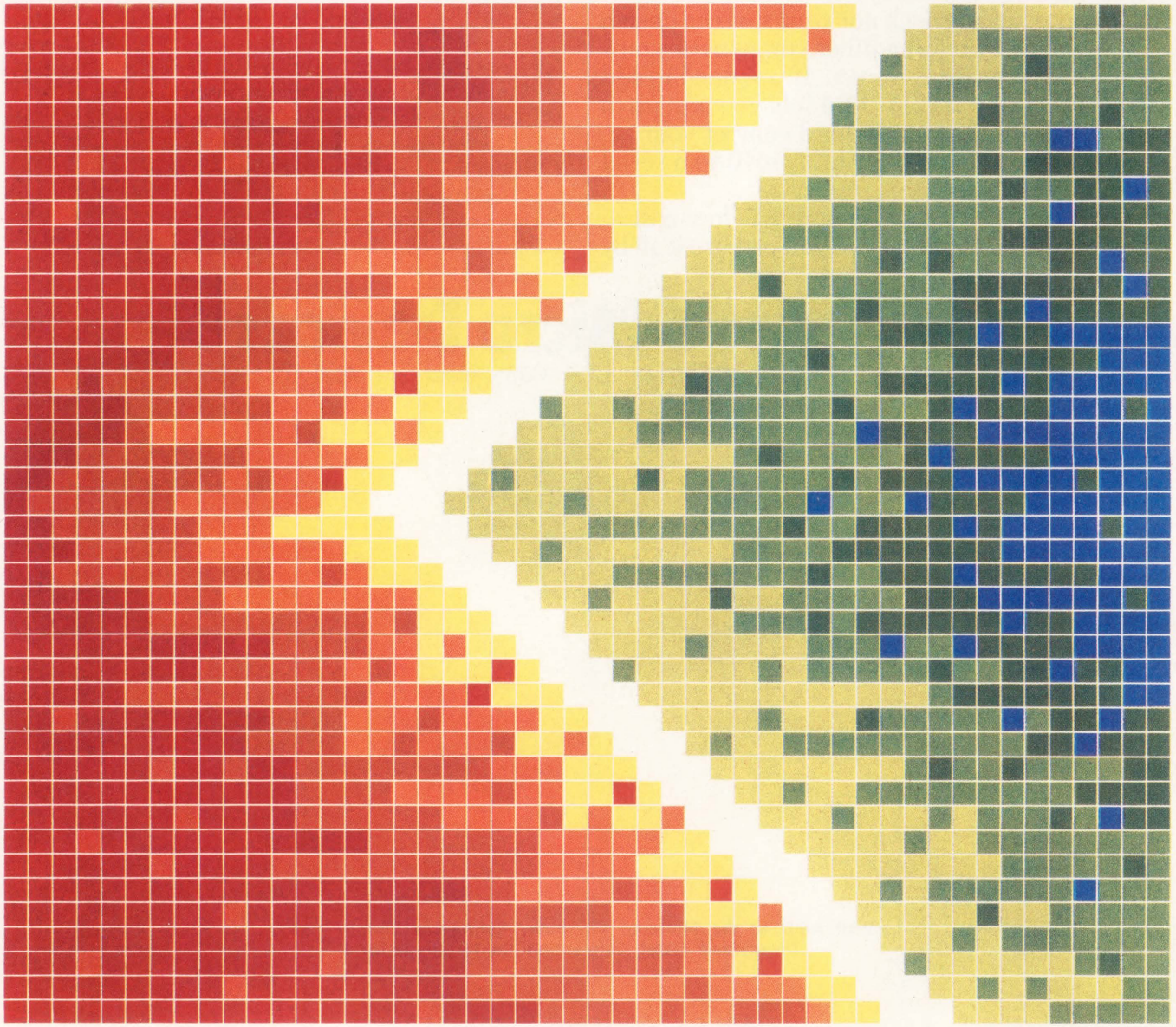


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CIRCLE 94 ON INQUIRY CARD

ENCODING SCHEMES SUPPORT HIGH DENSITY DIGITAL DATA RECORDING

Comparison of four classes of digital data encoding techniques shows some to be superior for high density magnetic tape applications. Packing density, overhead, efficiency, error rate, and inherent limitations of recorder hardware are among the design factors optimized by encoding scheme selection

Richard H. Severt Bell & Howell Datatape Div, Pasadena, California

Digital data are commonly supplied as pulse code modulated signals using a non-return-to-zero code format—a format both rich in dc content and requiring a high degree of time base stability to maintain bit synchronization with a separate, coincident clock signal. In apparent conflict with these code characteristics, magnetic tape recorders suffer from two major shortcomings that limit their suitability for recording and reproducing straight non-return-to-zero signals—time base instability and an absolute inability to reproduce dc signal components. Presently, recorders are being designed using an encoding scheme whereby the non-return-to-zero data are somehow modified to eliminate or to minimize the dc component and to provide the necessary time base stability that prevents loss of bit synchronization.

Several such encoding schemes have been developed and have proven effective in overcoming these recorder shortcomings. Included among such encoding schemes are delay modulation (also known as Miller codes), randomized non-return-to-zero (randomized-NRZ), and enhanced NRZ (E-NRZ) encoding. These encoding schemes are explored as to their advantages and disadvantages. Before engaging in detailed analysis, however, some methods in which pulse code modulated (PCM) data can be encoded are reviewed to establish a fundamental baseline for classification.

Encoding Scheme Classifications

Virtually all encoding schemes—whether suitable for high density recording or not—can be classified as belonging to one of four basic code groups: return-to-zero (RZ), non-return-to-zero (NRZ), bi-phase, and delay modulation (Miller). The four classifications are

identified in Fig 1, along with the waveforms for several separate codes belonging to each group.

RZ Codes

Return-to-zero (RZ) codes are inefficient for use in high density digital recording. Because of their simple structure, however, they serve as a convenient starting point toward an understanding of the more sophisticated encoding schemes. The simplest encoding scheme is the return-to-zero, or RZ pulse. A 1 is represented by a positive going pulse and a 0 by a negative going pulse. This particular code finds applications in elementary equipment, but inefficient use of bandwidth restricts it from high density applications. It is a redundant coding scheme, requiring two flux transitions for each signal bit.

Return-to-bias (RB) is a slightly more efficient RZ encoding scheme, one that remains at the maximum positive or negative excursion in the absence of a signal. A 1 is represented by an isolated pulse from one extreme of signal to the other or, in the case of tape, from saturation in one direction to saturation in the other direction. At the end of the pulse, the original value is resumed, and a total of two flux transitions are required for each 1. A 0 is represented by the absence of a pulse.

NRZ Codes

Of the four code classifications, NRZ codes provide the most efficient use of available bandwidth and are the easiest to engineer and maintain. They are the most widely used codes for electronic data processing and are equally suitable for high, medium, and low density electronic data processing (EDP) applications. The two outstanding characteristics that make the NRZ codes so widely accepted by the EDP industry, bandwidth and efficiency, make them equally attractive for high density recording. There are, however, two limitations that must be overcome to make NRZ codes compatible with magnetic recorders.

The first limitation is the presence of a substantial dc component in the straight (unencoded) variations of the NRZ code, which is unacceptable to the recorder. This dc component results from the fact that straight NRZ codes are not "run-length limited," meaning that there are no built-in safeguards to prevent the data stream from containing long, uninterrupted strings of 1s or 0s. To preserve such long strings of 1s or 0s without distortion, it becomes necessary for the response of the recorder to extend very close to dc.

The second limitation imposed by straight NRZ codes is the requirement for an extremely stable time base to prevent loss of bit synchronization as data are clocked through the recorder. At very low bit densities, up to about 800 bits/in (314/cm), the degree of time base stability provided by the recorder is normally sufficient to maintain bit synchronization through the use of an external, synchronous clock signal supplied along with the NRZ data on a separate line. As bit density increases above 1000 bits/in (393/cm), however, the degree of time base stability provided by the recorder becomes inadequate to maintain bit synchronization by this means, and a more effective means must be used.

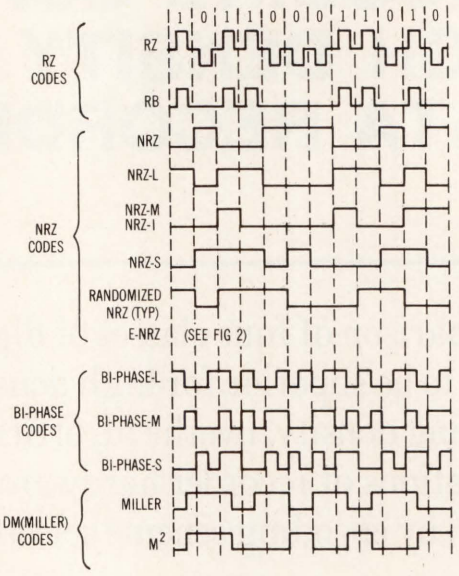


Fig 1 Digital data encoding schemes. Inefficient RZ codes require 2 transitions/bit. More efficient NRZ codes have unacceptable dc component. Bi-Phase codes lack dc component but require twice the NRZ bandwidth. Complicated Miller codes lack economical error detection and correction

One effective mechanism for achieving the necessary time base stability is to extract the timing clock signal directly from the transitions in the data stream. This assumes that a sufficient number of transitions exist in the data to ensure "lock on" by an internal timing oscillator. Unfortunately, because straight NRZ is not run-length limited, there is no assurance that sufficient transitions will be present.

In reviewing the two major limitations imposed by straight NRZ codes, the presence of a dc component and the requirement for an extremely stable time base, a definite commonality becomes apparent. Both limitations can be minimized simply by providing a safeguard that will guarantee the necessary minimum number of transitions in the data stream. This, in essence, is exactly what is done in the case of the "modified" NRZ codes, E-NRZ, and randomized-NRZ, to make straight NRZ encoded data acceptable to the recorder. Increasing the transition density does not, of itself, provide the most acceptable encoding scheme, however, as there are other factors that must be taken into consideration.

In comparing NRZ encoding with RZ encoding, redundancy is sharply reduced by assigning, at most, a

single transition to each separate bit. The information derived from this encoding scheme by the recorder is whether or not the flux has changed. There are several ways in which this information can be used to give a binary coding scheme. In straight NRZ, a flux change indicates that the bit following a given bit differs from its predecessor. Thus, a change from 1 to 0 is indicated by a flux change. For a series of consecutive 1s or 0s, no flux change is indicated; but when the last 1 or 0 is followed by a different bit, there is another flux change.

Non-return-to-zero level (NRZ-L) is a straight NRZ code, not acceptable for high density recording, in which a 1 is represented by one level, and a 0 is represented by the other level.

Non-return-to-zero mark (NRZ-M/NRZ-I) is a straight NRZ code that is not acceptable for high density recording. A 1 is represented by a change in level, and a 0 is represented by no change in level. The major advantage of NRZ-M over NRZ is the one to one relationship between the signal and the data. If there is an error, only the bit for which the error is made will be lost. In straight NRZ, on the other hand, if a flux transition is missing, all successive bits will be complemented until bit synchronization is somehow regained. NRZ-M encoding is used in 800-bit/in (314/cm) IBM compatible tape drives.

Non-return-to-zero space (NRZ-S) is a straight NRZ code that is not acceptable for high density digital recording. A 1 is represented by no change in level, and a 0 is represented by a change in level.

Randomized-NRZ is a modified NRZ code that is acceptable for high density recording at packing densities up to 30k bits/in (11.8k/cm) per track, with a bit-error probability (BEP) of 1 error/10^6 bits. This packing density is typical for a 28-track recorder with a 2.0-MHz passband. As the name suggests, straight NRZ data are processed through a randomizer to increase the number of level transitions before being recorded on tape. This reduces the dc component, making the data more acceptable to the recorder. The code is not run-length limited, however, so there exists a remote possibility that an NRZ pattern could nullify the randomizing process to produce unacceptably long strings of consecutive 1s or 0s.

Enhanced-NRZ (E-NRZ) is a modified NRZ code that is acceptable for high density recording at packing densities up to 33k bits/in (13k/cm) per track with a BEP of 1 error/10^6 bits. As shown in Fig 2, E-NRZ encoding entails separating the NRZ-L data stream into 7-bit words; inverting bits 2, 3, 6, and 7; and adding one parity (enhancement) bit to each word. The parity bit is added at the end of each word to make the total number of 1s in the 8-bit word an odd count.

Enhancement offers several advantages over straight NRZ and randomized-NRZ. First, it assumes a minimum transition rate sufficient to reduce dc components and maintain phase lock in the playback timing oscillator. Second, E-NRZ is run-length limited, providing, even under worst-case conditions, a minimum of 1 transition for every 14 consecutive bits. Third, by means of parity checks during playback, E-NRZ provides a good indication of the error rate at which the data were recorded and reproduced.

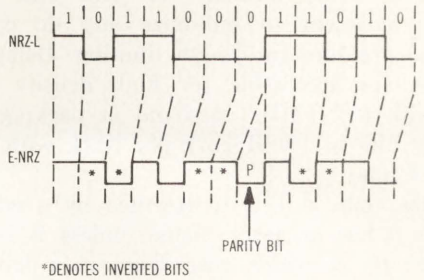


Fig 2 E-NRZ encoding. NRZ-L data stream is partitioned into 7-bit words. Bits 2, 3, 6, and 7 of each are complemented. Eighth bit produces odd parity. Clocking E-NRZ output at higher rate preserves time base ralationship

Bi-Phase Codes

Bi-phase codes have appeared in several variations and are known by many different names, including Manchester encoding, double-frequency encoding, phase encoding, and frequency shift encoding. All are characterized by having at least one level transition per bit. The coding rules for bi-phase codes are the same as those for NRZ-M, with the addition of one extra transition at the beginning of every bit cell. This results in a high transition density that makes the code totally dc-free and run-length limited, and therefore highly compatible with magnetic recorders. Unfortunately, this same high transition density requires twice as much bandwidth as NRZ codes to provide the same packing density. The inefficient use of bandwidth limits maximum packing density to about 16k bits/in (6.3k/cm), well below the minimum requirements for high density recording with a 2.0-MHz passband. Bi-phase encoding is used in 1600-bit/in (629/cm), IBM compatible tape drives.

Bi-phase level (Bi-$\emptyset$-L) is also known as split phase encoding. Level change occurs at the center of every bit period. A 1 is represented by a 1 level with a transition to the 0 level, and a 0 is represented by a 0 level with a transition to the 1 level.

Bi-phase mark (Bi-$\emptyset$-M) level changes occur at the beginning of every bit period. A 1 is represented by a midbit level change, and a 0 is represented by the absence of a midbit level change.

Bi-phase space (Bi-$\emptyset$-S) level changes occur at the beginning of every bit period. A 1 is represented by the absence of a midbit level change, and a 0 is represented by a midbit level change.

Delay Modulation (Miller) Codes

Miller and Miller-squared (M^2) are perhaps the most familiar members of the delay modulation (DM) code

group, characterized by having a minimum of one transition for every alternate bit cell. This transition density is sufficient to minimize any dc component, and it also provides run-length limiting. Delay modulation codes are acceptable for high density recording systems with a 2.0-MHz passband at packing densities up to 22k bits/in (8661/cm) per track with a BEP of 1 error/10^6 bits.

In Miller code, a 1 is represented by a midbit level change. A 0 has no level change unless it is followed by another 0, in which case there is a level change at the end of the first 0 bit period.

The rules for M^2 encoding are the same as those for Miller code, except when an isolated 0 is followed by an even number of 1s. Then, the midbit level change corresponding to the final 1 is inhibited.

Acceptable Encoding Schemes

Few of the encoding schemes discussed are suitable for high density digital recording. Both RZ and bi-phase codes suffer from inefficient bandwidth utilization. Straight NRZ codes, on the other hand, are handicapped by having too few level transitions, which results in the presence of a dc component that is unacceptable to the recorder. This narrows the field to only three encoding schemes that are classified as being suitable for high density recording: E-NRZ, randomized-NRZ, and M^2. Unfortunately, these three codes are not compatible, nor are they directly interchangeable. Designers of high density recording equipment must give careful and thoughtful consideration to all the advantages and disadvantages of each encoding scheme.

Maximum Theoretical Bit Rate

The theoretical maximum number of bits per track per second that can be recorded and reproduced successfully with any given recorder passband is known as the Nyquist rate (for NRZ codes) and is equal to twice the upper band edge (UBE) frequency limit of the recorder passband.

$$\text{Nyquist rate} = \text{Bits/s}_{max} = 2\ (\text{UBE})$$

For example, the Nyquist rate for a recorder with a 2.0-MHz passband is calculated as

$$\begin{aligned}\text{Nyquist rate} &= 2\ (\text{UBE}) \\ &= 2(2 \times 10^6) \\ &= 4\text{M Bits/s/track}\end{aligned}$$

Maximum Theoretical Bit Packing Density

Nyquist packing density is defined as the theoretical maximum number of bits per unit length of tape per track that can be recorded and reproduced successfully with any given recorder passband, and is equal to the Nyquist rate divided by the tape speed.

$$\text{Nyquist packing density} = \frac{2(\text{UBE})}{\text{Tape speed}}$$

For example, the Nyquist packing density for a recorder with a 2.0-MHz passband, operated at 120 in/s (305/cm), is calculated as

$$\begin{aligned}\text{Nyquist packing density} &= \frac{2(\text{UBE})}{\text{Tape speed}} = \frac{2(2 \times 10^6)}{120} \\ &= 33{,}333\ \text{Bits/in/track}\end{aligned}$$

Both the Nyquist rate and the Nyquist packing density are important for more than purely academic reasons since they govern the maximum performance attainable under ideal conditions with a perfect recorder and a perfect encoding scheme. In other words, they set the goal toward which design engineers must work to achieve maximum overall equipment performance. With parallel mode high density recording, however, two major limitations prevent this goal from being fully attained—the ratio of actual, usable bits to the total number of bits recorded (ie, overhead) and the maximum practical bit rate attainable for a given bit error probability.

Code Overhead

In parallel mode high density recording, not all the bits recorded on tape are actual, usable bits. Those bits that are not usable include the parity and sync word bits added to the data during encoding. Added bits comprise overhead because they occupy space on tape which would otherwise be occupied by actual, usable bits. Depending on the particular encoding scheme, the amount of space required for code overhead varies from about 3% to about 22% of the total space available.

Low overhead is one encoding scheme characteristic overemphasized in many cases. "The lower the overhead, the better the encoding scheme," is the premise. However, E-NRZ has the highest overhead (21.43%) and yet provides the second highest throughput rate.

Straight NRZ has no code overhead because all bits present are usable data bits. Unfortunately, this complete lack of overhead is what makes NRZ unsuitable for high density recording, because the code is not run-length limited and contains no sync words to ensure proper bit synchronization at the recorder output. Nevertheless, this lack of overhead makes straight NRZ the standard by which other codes are compared.

Randomized-NRZ has a code overhead of 3.2%, the lowest of the three major encoding schemes used for high density recording. With randomized-NRZ, a 16-bit deskew sync word is inserted into the data stream once for every 496 data bits. These 16 sync bits appended to every 496 data bits comprise the 3.23% overhead.

Both Miller and M^2 codes require one additional "master channel" for every 12 data channels. With Miller and M^2 codes, a 32-bit sync word is inserted into each data stream once for every 512 data bits. To accomplish this, 32 data bits are extracted from the normal data stream and are placed on the 13th "master channel." The 32-bit sync words are then inserted into the data stream to occupy the space from which the data bits were extracted. A meaningful overhead figure for these codes must consider the number of tracks required rather than the number of bits added. Thus, the master channel reflects 8.33% code overhead.

TABLE 1

Code Efficiency Ratings of
High Density Encoding Schemes

Code	Nyquist Bit Rate	Usable Bit Rate	Efficiency
Randomized-NRZ	4M bits/s/track	3.600M bits/s/track	90.00%
E-NRZ	4M bits/s/track	3.294M bits/s/track	82.35%
Miller-Squared	4M bits/s/track	2.640M bits/s/track	65.00%

In the case of E-NRZ encoding, 80 parity bits and 40 sync word bits are added to every 560-bit data frame. The 120 overhead bits added to the 560 data bits result in an E-NRZ data frame containing 680 bits. E-NRZ overhead is calculated as

$$\text{Percent overhead} = \frac{(560 + 80 + 40) - 560}{560} \times 100 = 21.43\%$$

Code Efficiency

Code efficiency provides a more meaningful insight into code performance than does code overhead. Efficiency is the ratio of usable per track bit rate to the maximum, theoretical per track rate (Nyquist rate) for the recorder passband, assuming equal BEP, as follows:

$$\text{Eff}_{\text{code}} = \frac{\text{Usable per track bit rate}}{\text{Nyquist per track bit rate}} \times 100$$

Table 1 lists the comparative code efficiency ratings for the major encoding schemes used in high density recording. The efficiency figures assume a 28-track recorder with a 2.0-MHz passband, and a BEP of 1 error/10^6 bits.

Spectral Density Comparison

Since the ultimate objective of a high density digital recording system is to maximize the amount of information that can be stored on a reel of tape, it follows that the slowest possible tape speed is desired. Consequently, digital encoding schemes must make efficient use of the recorder passband—thereby maximizing the bit packing density, the number of bits per linear inch of tape.

Passband requirements for the various encoding schemes are often determined by examination of the signal power spectrum. Some arbitrary portion of the total power is then assumed to be required for adequate recovery of the data, and the recording system is designed accordingly. However, the power spectrum does not indicate how restricting the passband affects the signal waveshape. Thus, the spectral power density does not, of itself, provide ample indication of what happens when the digital signal is processed through a channel having finite attenuation rates in the stop-band, and imperfect phase linearity, as in the case of magnetic tape recorders.

Fig 3 plots the power spectral densities for NRZ, bi-phase, and Miller coding. At first glance, it may appear that the spectral density of the Miller scheme is the most suitable for high density digital recording because of the apparently narrow passband requirements and the apparent reduction in spectral energy in the vicinity of f = 0. Emphasis is on the word "apparent." With Miller coding, the majority of the signal energy "appears" to lie in frequencies less than one-half the bit rate. The "appearance" is somewhat misleading, however, since in actual practice, Miller requires a passband up to 33% wider than NRZ coding to achieve the same packing density.

The Miller spectrum seems small at f = 0. Once again, this appears to be an advantage, since recorder

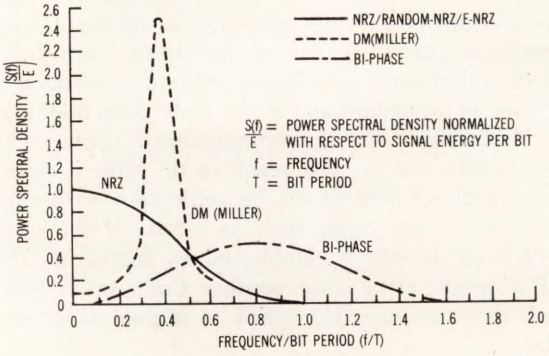


Fig 3 Power spectral density of NRZ, Bi-Phase, and DM encoding schemes. Narrow bandwidth and low dc component appear to favor DM as best choice. This is misleading because worst-case DM bit patterns produce significant dc component

response at low frequencies is poor when using the direct method of recording, as in the case of high density. In actual practice, however, the dc component of the Miller spectrum can reach as much as 33% of the peak-to-peak value when worst-case bit patterns are encountered.

As a direct result of these two factors, it begins to become apparent that higher packing densities can be achieved only with NRZ derived codes such as the E-NRZ encoding technique.

BEP Versus Signal-to-Noise Ratio

Theoretical BEP versus signal-to-noise (S/N) ratio curves for NRZ, bi-phase, and Miller coding, presented in Fig 4, show that a BEP of 1 in 10^6 would require a recorder S/N ratio of 17 dB or more, using the Miller encoding scheme, but only 14 dB when using NRZ or bi-phase encoding. Expressed another way, a recorder having a 12-dB S/N ratio would provide a theoretical BEP of only 1 in $10^{2.5}$, using Miller encoding, while the same 12-dB S/N ratio would provide a BEP of 1 in $10^{4.5}$, using NRZ encoding, an improvement of two orders of magnitude.

The inherent BEP vs S/N ratio performance of NRZ codes applies directly to E-NRZ. Theoretical and experimental curves have been published depicting this important NRZ relationship. While well-established for NRZ and E-NRZ, this relationship is not shared by other encoding schemes.

Some designers consider DM to be an efficient coding technique because of its small low frequency content and a sharply peaked spectrum at about the 0.4-bit rate. This conclusion is unwarranted and reflects a misunderstanding of DM performance. In fact, the performance of DM is 3.5-dB poorer than that of NRZ, using an optimum detection bandwidth twice that required for NRZ. If the bandwidth is limited to the spectral region below the bit rate, DM exacts a considerable penalty in bit error performance (see Bibliography, Waggener).

Proponents of Miller encoding recognize the 3.5-dB penalty but tend to discount its importance. An S/N ratio margin of 3.5 dB provides a safeguard against operational problems caused by head varnish, head azimuth, electronic misalignment, and crossplay. Tape dropouts of a magnitude at or near detection and bit sync thresholds will be accommodated using NRZ and E-NRZ, while errors will result with Miller codes. Increased packing density can be achieved with a superior BEP vs S/N ratio code, such as E-NRZ, if the criterion for packing density is established by increasing density until a given error rate results. Code evaluation has shown that NRZ can be packed at higher densities than Miller.

Minimum Transition Density

Minimum transition density is the average number of logic level transitions in the bit stream. The minimum transition density for any encoding scheme is important because it governs the low frequency requirement of the recorder passband. The fewer transitions, the lower the frequency requirement. In an extreme case where there are very few transitions, the low frequency response would have to extend down to dc, well below the capability of wideband direct record and playback systems.

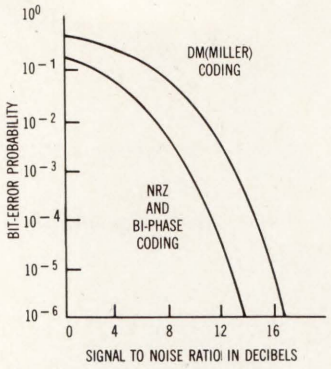


Fig 4 Theoretical BEP vs S/N ratio for NRZ, Bi-Phase, and DM. Typical recorder S/N ratio of 12 dB gives NRZ two orders of magnitude improvement over DM (Miller) codes

Miller coding offers a transition density of 50%, regardless of bit pattern. This apparent advantage is obtained at the expense of spectral compression, which is detrimental. The 50% Miller transition density goes beyond the point of diminishing returns and constitutes an overreaction when viewed from the performance baseline of a well-designed bit synchronizer. The transition density of M^2 encoding, at 33%, is only a slight improvement over Miller codes and still beyond the point of diminishing returns.

No claim is made for the minimum transition density for randomized-NRZ. However, it is not difficult to envision a string of 0s, 20 to 40 bits long, resulting in a randomized output lacking transitions. It would be difficult, if not impossible, to specify the minimum transition density of randomized-NRZ.

The worst-case transition density with E-NRZ encoding is one transition in 14 bits (7.15%). This minimum transition density is a major improvement over randomized-NRZ, which has no guaranteed minimum, and brings the low frequency requirement necessary to process the code well within the passband of standard direct record and playback systems—with well-defined performance parameters for dc restoration.

Bit Pattern Sensitivity

Bit pattern sensitivity is the susceptibility of a code to certain bit patterns that increase BEP over and above the bit error rate for more benign bit patterns. In practice, bit pattern sensitivity usually results from low transition density coupled with highly asymmetrical bit streams; that is, long strings of 1s or 0s. This type

of bit pattern is most responsible for baseline shift because of the recorder's inability to pass very low frequency components.

E-NRZ encoding limits dc baseline shift so that it can never reach either 0 or 100% of the pulse train amplitude. Specifically, the baseline is bounded between 12.5 and 87.5% of the peak to peak pulse amplitude.

The percentage of baseline shift experienced with various encoding schemes can be reduced, and even totally eliminated, through the use of effective dc restoration circuits in the recorder. In weighing the various merits of one high density digital recorder over another, consideration should be given to both the presence of dc restoration circuits and their effectiveness.

Dc restoration is recommended for use in all high density recorders, regardless of the encoding scheme employed. Both the nominal cost and the complexity of including this feature are low compared with its effectiveness in reducing baseline shift. It is further recommended that all multispeed recorders incorporate scaled dc restoration circuits; that is, that the time constants of the dc restoration circuits be changed automatically and proportionately with tape speed. The effectiveness of a properly designed dc restoration circuit in reducing baseline shift is shown in Fig 5. These tests were performed using straight NRZ-L encoding at a packing density of 33k bits/in (12.9k/cm). Tape speed was 60 in (152 cm)/s, using a standard 28-track recorder with 1-in (2.54-cm) tape.

Designers are cautioned about reports of the comparative superiority of dc-free codes over E-NRZ, when tested at various recording levels and bit packing densities. Such tests have been performed with no dc restoration, or with marginal dc restoration adequate only for spectrally compacted Miller codes. In effect, these tests were measurements of dc restoration inferiority, rather than proof of code superiority.

Bandwidth Sensitivity

E-NRZ, like straight NRZ, enjoys an additional bandwidth related advantage over non-NRZ codes in its low sensitivity to changes in bandwidth that may occur between reels of tape, or within a single reel of tape. NRZ bit packing is more sensitive to tape recorder bandwidth changes than bi-phase encoding, but less sensitive than Miller codes. It is the spectral density compression that makes Miller codes more sensitive to bandwidth changes.

Instead of being compressed into a narrow band of spectral energy, as in the case of Miller codes, E-NRZ makes better use of the full recorder passband. Hence, E-NRZ is less sensitive to upper band edge phenomena such as head varnish, azimuth misadjustment, and imperfect equalization. This relative insensitivity to upper band edge phenomena makes E-NRZ signal electronics easier to align and calibrate than delay modulation electronics.

Bias Level Sensitivity

NRZ is more sensitive to bias changes than bi-phase, but less sensitive than delay modulation. NRZ exhibits only a 3% loss in bit density at 0 dB for a tape speed of 30 in (76 cm)/s. It is likely that the band edge self-erasure from the bias level changes created phase response changes, which reduce the phase margin (intersymbol interference) for proper decoding of Miller and similar codes.

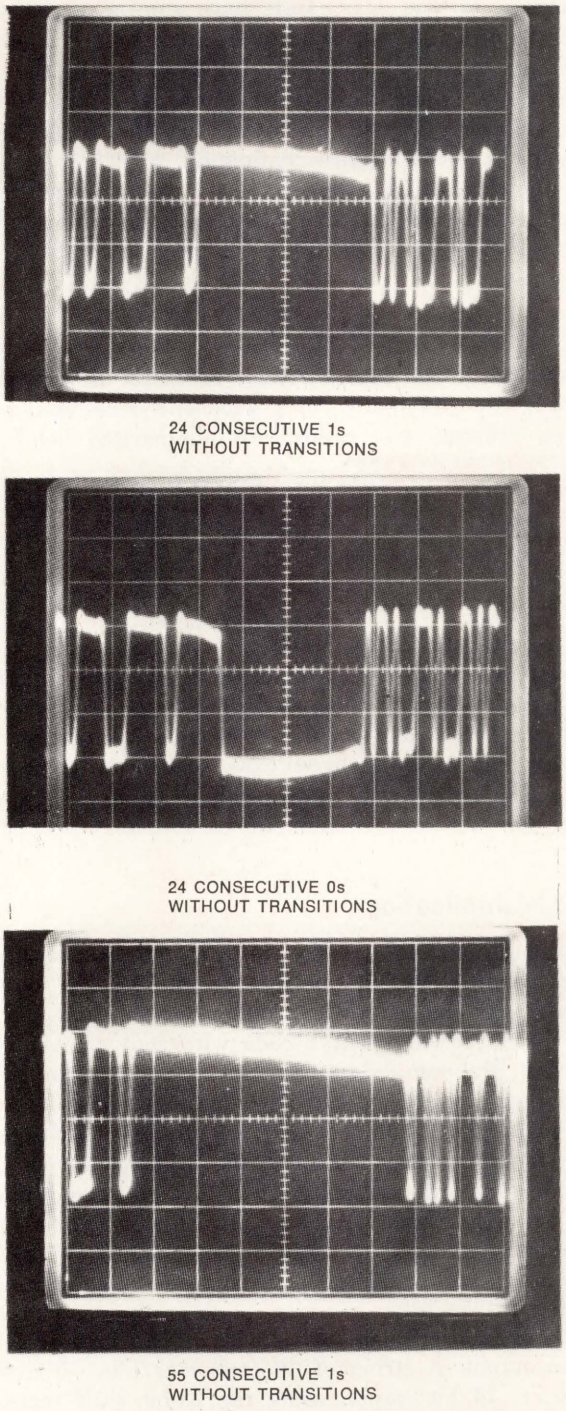


Fig 5 Effectiveness of dc restoration. Long strings of consecutive 0s or 1s cause baseline shift because recorder cannot pass dc. Photos show how dc restoration circuit reduces baseline shift

Recording E-NRZ or any other bi-level signal is best performed without bias. Tests have shown consistently better recorded levels, and lower bit error rates, with nonbiased recording. The net improvement in the recorded level alone can be as great as 3 dB, which improves the off tape S/N ratio. The choice of E-NRZ encoding does not require elimination of high frequency bias, if the designer wishes to retain an IRIG compatible direct record configuration. Successful operation at 32k bits/in (12.6k/cm) per track has been reported.

Sensitivity to Crossplay

Sensitivity of various encoding schemes to crossplay between two different 2-MHz wideband recorders, possessing different S/N ratios, are summarized below:

	Percent Reduction in Packing Density Due to Crossplay	
Tape Speed	NRZ	DM
30 in/s	23%	30%
120 in/s	11%	33%

The results are not surprising, considering the compression of the Miller code spectrum, coupled with the doubled clock requirement under that encoding scheme. Both of these shortcomings become apparent when crossplaying tapes between two different recorders. Again, the wider frequency distribution of E-NRZ over Miller provides greater immunity to crossplay problems.

Error Multiplication

Error multiplication is the property of an encoding scheme that results in an increase in decoder output errors over and above the output errors that would have been present using a code with zero error multiplication. Randomized-NRZ is one example of an error multiplication code. Specifically, the derandomizing process inherently contains two types of error multiplication—from circulation through the feedback loops, and from bit slip. For example, circulation error multiplication causes a single erroneous bit at the input to the derandomizer to result in three errors at the derandomizer output, regardless of shift register size. Using a 23-bit shift register, a string of 23 erroneous bits at the derandomizer input will result in 46 erroneous bits at the output. A string of 46 erroneous bits will result in 46 + 23 bit errors, using the 23-bit shift register, 1.5 times the offtape error rate.

The circulation error multiplication examples are typical of the type of burst errors encountered when using currently available wideband analog tape for high density digital recording. In contrast, bit slip error multiplication occurs when a single bit error at the derandomizer input disrupts synchronization of the derandomizing process. With the same shift register, 23 error-free, unslipped bits must purge the derandomizing buffer before an error-free output results.

Miller codes possess a similar trait, in that the Miller decoder must receive a 1 0 1 pattern to be synchronized for proper decoding. If either bit slip or burst errors occur, the Miller decoder must be purged by the 1 0 1 input pattern before an error-free output results. The M^2 code shares this disadvantage.

E-NRZ encoding is an example of a zero error multiplication code. It contains no inherent mechanism for the multiplication of errors over and above the flaw rate of the tape being recorded and reproduced. Neither NRZ nor E-NRZ codes require purging of the decoder to reestablish error-free output. A single bit in error, off tape, will result in only a single-bit error at the decoder output.

Bit Slip

Bit slip is the increase or decrease in clock frequency by one or more bit times with respect to the input signal. One of the unique characteristics of E-NRZ encoding is its recovery potential from bit slip. Incorporation of parity bits in every eighth bit position of the E-NRZ encoding scheme provides, in effect, an electronic "sprocket" which can be used during playback decoding to combat bit slip. If bit slip occurs, the parity bit position will move ahead or backward in time by one or more bits. Inspection for odd parity over a group of 8-bit words will detect bit slip and determine its direction and magnitude. Five 8-bit words must be inspected using a 40-bit register. Once the slip direction and magnitude are known, correction is greatly simplified. Encoding schemes that lack the sprocket property of E-NRZ cannot recover from bit slip until a unique bit pattern arrives at the input, such as the 1 0 1 pattern required by Miller codes, or until a suitable time period has elapsed, such as the 23-bit delay required by randomized-NRZ.

In a parallel mode digital recorder, if bit slip is not corrected with deskew buffers, the track experiencing bit slip will not be properly deskewed until the arrival of the next deskew frame sync word, typically 500 to 600 bits later. E-NRZ tracks can be bit-slip corrected immediately, without waiting for the next deskew frame sync word.

Confidence Monitoring

The structure of E-NRZ encoding makes realtime confidence monitoring relatively easy. As soon as an error burst begins, odd parity will no longer be satisfied—a condition easily detected with conventional parity check circuitry. Error monitoring is accomplished by simply adding a parity error bus and indicator for each track to indicate error activity.

A single parity error can mean that an error burst of from one to seven bits in duration has occurred. Because of the fixed relationship between word bits and parity bits, with one parity bit for every seven word bits, the occurrence rate of parity (word) errors is a highly reliable indicator of recorded data quality. While other codes may possess structuring suitable for confidence monitoring, implementation is usually more costly.

Eye Patterns

Overall performance characteristics of a high density digital recorder can be determined by observing the

analog output waveform from the reproduce amplifier (see Fig 6). This waveform is often called the eye pattern because of its shape. The open area between the top and bottom of the pattern is called the decision area, and it is within this area that the determination between a logic 1 and a logic 0 is made. A wide decision area that is relatively free of unwanted transitions results in fewer bit errors in the reproduced data. Both the width of the decision area, and the number of unwanted transitions are directly related to bit packing density, and to the encoding scheme used.

Through mathematical analysis it can be shown that any step-function waveform, such as the digital data, is actually composed of a fundamental sine wave frequency and an infinite number of harmonic components. To pass such a signal without distortion, a device must have sufficient bandwidth to pass not only the fundamental frequency but a certain number of the harmonic components as well. If, as in the case of the analog reproduce electronics, the passband is only sufficient to pass the fundamental, harmonics will be filtered out and only the fundamental sine wave will appear at the output. This, in essence, is the basis for the formation of the eye pattern. The filtering effect of the reproduce electronics can be seen by comparing waveforms (a) and (b) in Fig 7.

If the filtered output of the reproduce amplifier [waveform (b)] is applied to the vertical input of an oscilloscope, and if the oscilloscope is triggered externally from the clock signal that accompanies the waveform [waveform (c)], various segments of the data stream will be superimposed on one another to form the characteristic eye pattern. This formation of the eye pattern by superimposing one segment on another is shown in progressive steps in waveforms (d), (e), (f), and (g).

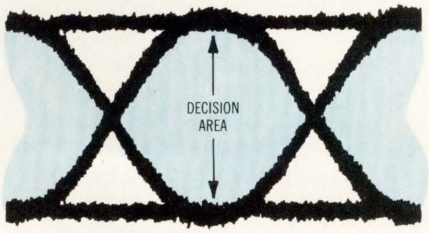


Fig 6 Typical eye pattern showing decision area. Recorder performance is characterized by width of decision area, in which logic 0 is distinguished from logic 1. Wide decision area, free of unwanted transitions, produces fewer bit errors. Width relates directly to encoding scheme and packing density

Summary

The properties of E-NRZ encoding have been presented and, in part, compared with competing encoding schemes. Table 2 lists these properties along with the comparative ratings of four major encoding schemes. E-NRZ is an uncomplicated code that is readily understood, simple to engineer, and easy to maintain. E-NRZ alignment procedures are less complicated because of wider adjustment margins and the time interval between recorder recalibration and alignment is also greater. The encoding scheme requires no complicated algorithms, no truth tables or lookup tables, and no complex circuitry. This simplicity results in total cost that is less than that of more complicated encoding schemes.

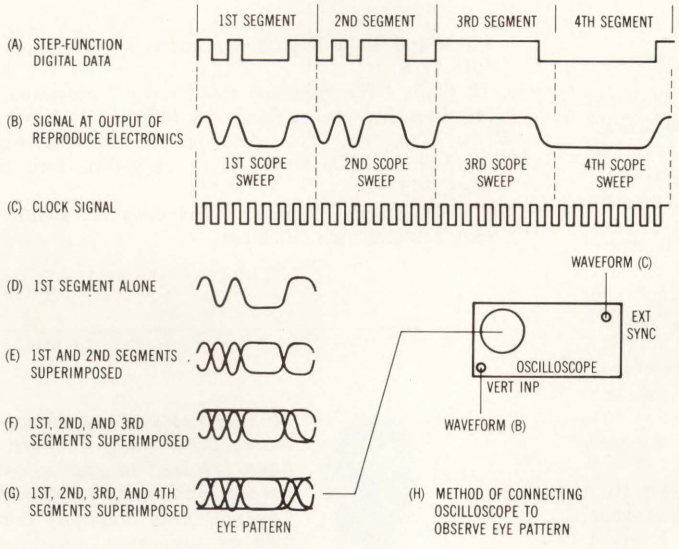


Fig 7 Formation of eye pattern. Digital data is composed of sine wave harmonics. Triggering vertical input from external, waveform clock superimposes data stream segments to form eye pattern. Signals (B) and (C) connected as shown, produce eye pattern in progressive stages (D), (E), (F), and (G)

TABLE 2

Code Comparison Chart of
Parallel Mode High Density Recording

Characteristics	Miller	Miller-Squared	Randomized-NRZ	E-NRZ
Theoretical maximum per track packing density[1] (bits/in)	33.33k	33.33k	33.33k	33.33k
Maximum data per track packing density[2] for bit error probability of 1 in 10^6 (bits/in)	22.00k	22.00k	30.00k	27.45k
Code efficiency	66.00%	66.00%	90.00%	82.35%
Code overhead	8.33%[3]	8.33%[3]	3.23%[4]	21.43%[5]
S/N ratio required for bit error probability of 1 in 10^6	17.00 dB	17.00 dB	14.00 dB	14.00 dB
Baseline remains stable even when transition density is low	Yes	Yes[6]	No	Yes
Immunity to error multiplication problems	No	No	No	Yes
Ability to recover from bit slip errors	Fair	Fair	Fair	Excellent
Immunity to bandwidth changes due to changes in record current and/or differences in tape	Fair	Fair	Good	Good
Error correction capability	No	No	No	Yes
Synchronous clock requirement	2 times bit rate	2 times bit rate	Same as bit rate	Same as bit rate

1. Maximum packing densities specified assume passband of 2.0 MHz at 120 in/s
2. Packing densities are for 28-track recorders with 2.0-MHz passbands
3. One extra sync track required for every 12 data tracks = 8.33% overhead
4. 16 sync bits added to every 496 data bits = 3.23% overhead
5. 80 parity and 40 sync bits added to every 560 data bits = 21.43% overhead
6. Certain bit patterns will result in considerable dc (or near dc) spectral components that will produce baseline shift or "gallop"

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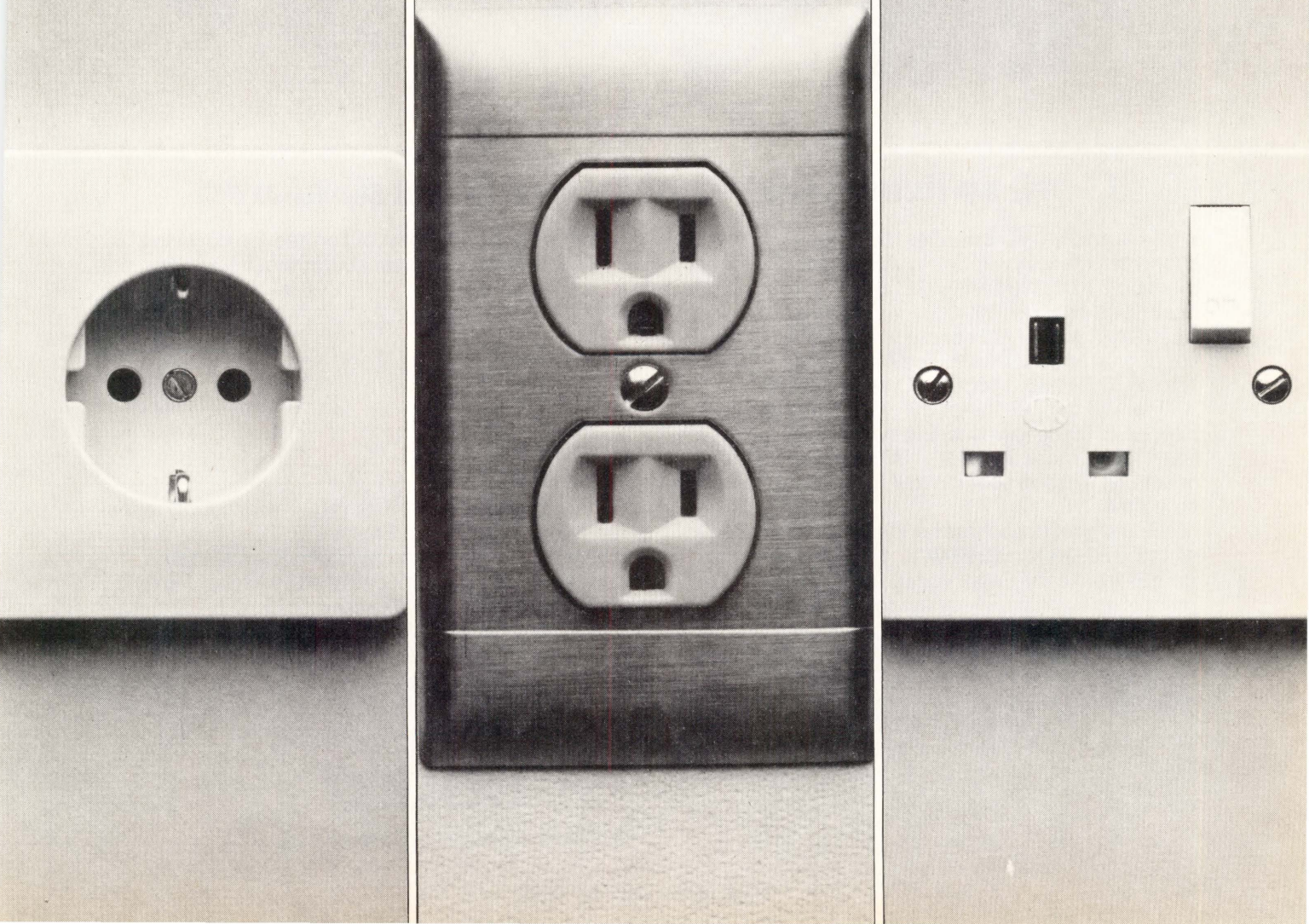


With 23 years of experience in the communications field, Richard Severt has been involved in sophisticated tape recorder technology for the last 12 years. The author of company publications as well as numerous papers in the field, Mr Severt is currently a marketing communications specialist at Bell & Howell's Datatape Div.

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Kommt ir computer auch damit zurecht?

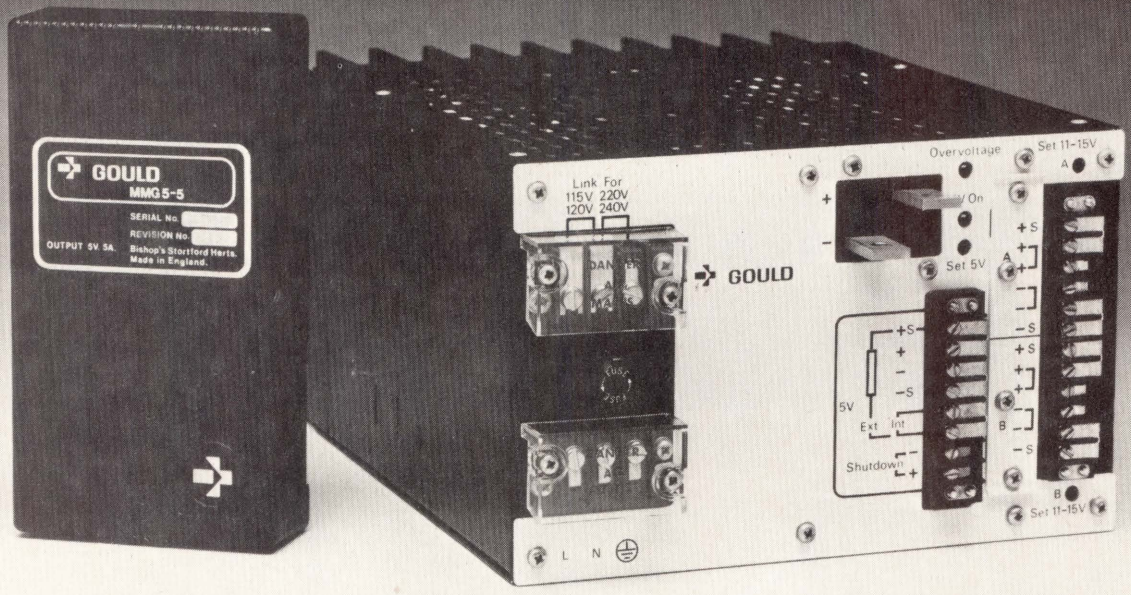
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15	X	X	X		X			X
24	X	X	X		X	X		X
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REDESIGN OF A COMMERCIAL MICROCOMPUTER FOR SEVERE ENVIRONMENTS

Ruggedized version of commercial single-board microcomputer implements reliable automatic control systems in hostile environments

A. D. Ballantyne EMM/SESCO, Chatsworth, California

Increasing cost- and performance-effectiveness of microcomputer controlled systems suits them for use in automatic process control systems. System designers face a different and difficult set of system problems when introducing microcomputers into rugged industrial surroundings. Special purpose microcomputer systems developed for the military can operate within severe environments but are expensive and application bounded, while readily available commercial microcomputers do not function reliably under hostile operating conditions. Ruggedized microcomputers incorporate environmental safeguards developed for the military with standard, commercial microcomputer architectures to provide an effective, economical approach to industrial process control.

Process control applications may confront designers with severe environments such as those found in steel mills, machine shops, shipping docks, oil drilling platforms, and chemical refineries. Because the environment may not be well defined, the designer must identify significant environmental factors that the final microcomputer design will have to survive. The major problem presented by industrial environments is accurate specification of the environmental conditions under which the unit will operate.

Temperature Considerations

Thermal effects are usually a primary consideration for rugged microcomputer operation. Two main sources of

heat—the surrounding atmosphere and internal dissipation—must be investigated. The microcomputer must not overheat because of exterior or interior thermal influences; therefore, temperature extremes need close analysis.

Electronic parts and devices are usually specified to either of two operational temperature ranges: a 0 to 70 °C commercial range or a −55 to 125 °C military range. Manufacturers use similar methods to fabricate logic chips for both temperature ranges. The difference relates to process controls and testing performed, not only to achieve the temperature range, but also to support higher reliability. This is particularly true of transistor-transistor logic (TTL) and bipolar devices. For complementary metal oxide semiconductor (CMOS) and other metal oxide semiconductor (MOS) technologies, internal transistor geometry may change in the mask if the device is intended for wide temperature range operation.

Components are protected from overheating principally because device specifications cease to apply above the upper temperature limit and the probability of failure to perform within specification limits increases dramatically. When devices are stressed toward their upper temperature limit, the probability of failure at some future time increases rapidly as the semiconductor junction temperature rises. Most military designs require that junction temperatures not exceed 110 °C under worst-case operational conditions.

Commercial grade designs generally depend on ambient air flow across the parts for cooling. Ambient air cooling is seldom permitted in equipment designed to meet military requirements. For many commercial applications in severe environments, an air-cooled approach may not be desirable because of airborne contamination. A different approach to cooling logic devices normally characterizes the design of ruggedized computer equipment.

Fig 1(a) shows the heat dissipation path from a typical integrated circuit (IC) chip to an infinite heat sink. Two major elements are significant. First, there is a thermal resistance from the chip junction to the equipment case, the major thermal capacitance in the assembly. Primary heat extraction occurs directly from the case to the air flow. Second, cooling is achieved by transferring heat in the case to the printed circuit (PC) board and then to the air flow. Since the chip body is rarely bonded, heat flows to the board through the device leads and through an air gap beneath the chip. The board is usually an epoxy material; thus, the total efficiency of the transfer is fairly small compared with the major air path. Because air cooling is efficient with a turbulent air flow, the assurance of turbulence must be carefully considered during board layout of critical components.

Fig 1(b) shows the design philosophy behind IC chip cooling in ruggedized equipment. Mounting the chip on a silica-filled pad permits differential expansion between the IC body and the copper heat sink without lead stress, while maintaining an air-free bond to the heat sink. A secondary cooling path through the component leads remains, but this is so minute compared with the efficiency of the primary path that it may be ignored. Heat extracted from the device is still passed to the heat sink, but there is now a continuous mechanical path independent of air flow at the device.

Most ruggedized equipment designs do not remove the heat directly from the heat sink. They depend on further mechanical conductance to a heat exchanger, so that air flow at the component is not required. Heat generated in the components is dissipated elsewhere, independent of the rate of air turbulence at the component. Commercially designed equipment depends to a great extent on the ambient air properties. Consequently, ambient air quality should be considered as the next step in the environmental design process.

Air Quality

Initial installations of computer equipment on the factory floor extended office environment designs by providing an equipment cabinet or, more often, an equipment room shielded from factory contaminants. Frequently, equipment shielding is not sufficient for industrial applications. Many equipment rooms are only partitioned areas that prevent relatively large airborne particles from impinging directly on the equipment but do not offer a significantly filtered atmosphere. Mounting the equipment in filtered cabinets provides necessary secondary shielding.

Equipment rooms and cabinets present an additional drawback in that routine cleaning and maintenance may be performed by unskilled staff. When filters are left off, mispositioned, or insecurely fastened, problems caused by dirt and airborne particles as small as 100 μm should be expected. Many heavy industrial plants present unique problems. In areas where metals are being cut, formed, or welded, conductive material such as iron oxide or aluminum dust will be present in the air. Near some industrial processes, a variety of airborne hydrocarbon solvents and other corrosive chemicals may attack the solder or copper wiring, a problem air filters cannot adequately solve.

Designers must attempt to isolate the equipment from damaging industrial environments. Obviously, the commercial method of air cooling becomes less desirable and offers some significant disadvantages. Packaging that achieves full conductive cooling isolates PC board assemblies from the surrounding atmosphere. The chassis, sealed off from the environment, could be hermetically sealed if required. It may be cooled by natural convection or by forced air convection. In the latter method, filtering of external air or shielding is required only to remove large particles, since airborne material or solvents will not make physical contact with the electronic assemblies.

Humidity

Humidity is also a significant problem. Many designers specify basic humidity requirements for PC boards without investigating the expected industrial environment.

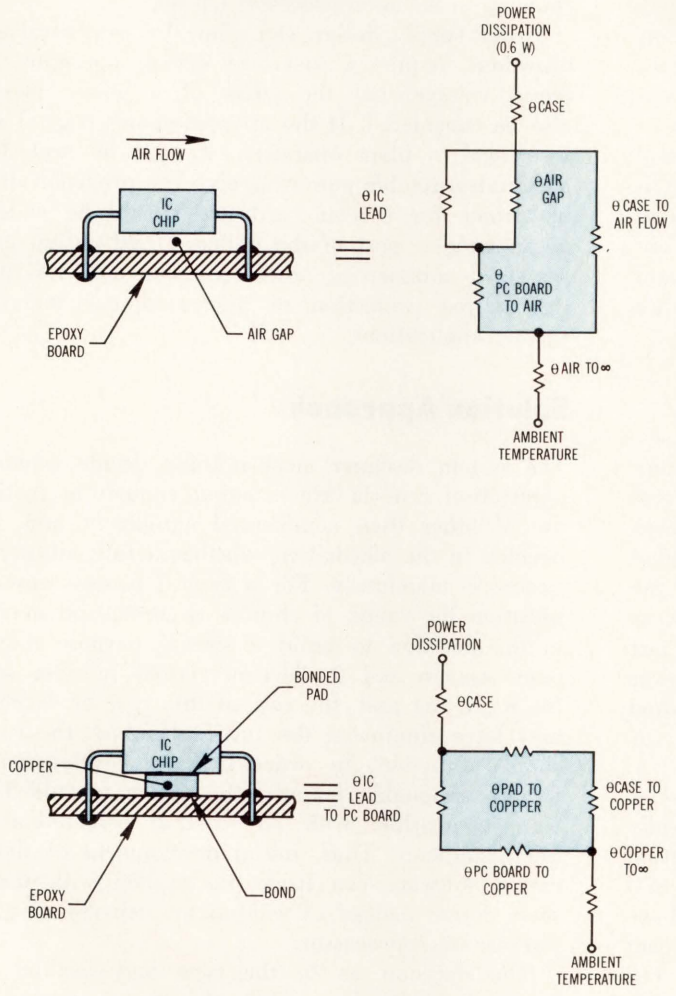


Fig 1 Commercial and ruggedized equipment cooling. Two major elements of heat dissipation from typical IC chip to infinite heat sink are depicted in (a). Chip junction has thermal resistance to equipment case, which is major thermal capacitance of assembly. Primary heat extraction occurs directly from case to air flow. Cooling is achieved by transferring heat in case to PC board and then to air flow. Difference in equipment cooling method for ruggedized environments (b) allows for secure dissipation of heat generated in components independent of rate of turbulence of impinging air stream. Chip is mounted on silica-filled pad to permit differential expansion between IC body and heatsink without lead stress, while maintaining air free bond to copper heat sink

For some applications, the requirements state only that the microcomputer should be mounted in an equipment room, within a cabinet, inside the factory. Yet an extreme application such as an offshore drilling platform may expose the equipment to sea air, and the equipment room may be hosed routinely with salt water.

In commercial applications where these extremes are not encountered, humidity usually ranges from 0 to 80% without condensation. Ruggedized equipment will assume up to 95% humidity with condensation. In the extreme case of an offshore drilling platform, possible equipment usage must be anticipated, and the equipment protected from direct contact with salt water.

Shock And Vibration

For shock and vibration effects, the environmental problem involves transient, short term disturbances and sustained, long term vibration. Because the precise environment in which the equipment must perform cannot be clearly defined, the standing design rule considers a worst-case approach to the application.

Short term shock and vibration loads usually result in momentary open circuits in connector and board interconnections. These loads can have drastic effects on the operational capability of the hardware and must be considered from the outset of system design. The

military has never approved of standard commercial board edge connectors, mainly because these connections will open under shock loads as small as 3 to 5 G. A standard military connector such as a fork and blade connector that accommodates up to 20 G shock and vibration is preferred over the board edge connector, despite cost disadvantages.

A wise precaution is to minimize board deflection under shock and vibration. Aluminum stiffening bars may be secured to the PC board assembly where excessive deflection is expected. In most cases, 0.25 x 0.25″ (0.63 x 0.63-cm) stiffening bars reduce the total deflection to less than 0.040″ (0.102-cm) double amplitude. Long term vibration effects are also best treated by reducing board deflection. This is achieved by minimizing the unsupported span of the PC boards and ensuring a minimum of movement at the assembly's fundamental natural vibrational frequency.

Power

Critical design factors include the quality of incoming power. In a heavy industrial plant running several kilowatts of rotating machinery, start-up transient power loads of seven to ten times normal running load are common. Internal 115-V distribution within the plant will show the effects of these power surges as low voltage during the transient load, which may last 3 min for a 10-kW motor. Microcomputer system power supplies must be designed to maintain their specified output characteristics during such disturbances, or process control may be affected.

Most large motor assemblies use 3-phase, 3.3- or 11-kV distribution, and are well-balanced electrically with respect to the neutral bus bar. In some distribution schemes, the transient load may not be balanced, and the neutral or star point may be several volts above ground. For a 10-kW factory air conditioner, a transient offset exceeding 20 V could appear on the 115-V bus bar in an improperly balanced system. The establishment of true system ground becomes critical, since the nominal dc signal ground at some plant locations may differ from that at the microcomputer location by several volts. Accurate definition of dc ground with reference to the microcomputer ground is essential to ensure that the microcomputer input/output (I/O) bus properly recognizes remotely sensed I/O devices. Twisted pair sensing on remote contacts is used so that no ground reference need be taken from the remote location. Where wire runs exceed 100′ (30 m), or where large transient power swings are observed, the sensor may reference its local ground and send the signal to an optical isolator. This device is a light emitting diode (LED) and a photosensor in one package. The remote sensor activates the LED, and the photoelectric sensor is referenced to microcomputer ground. Since light emitted by the LED is the only transmission medium, no differential ground voltage appears at the microcomputer and proper signal reception is assured.

Another problem associated with power distribution in heavy industrial plants results from short duration, high voltage, transient spikes that are observed during closure of power relays and contactors. Operation of a power control relay can produce surprising results, with 10-kV transient voltage spikes that decay in less than 1 ms superimposed on the 115-Vac line. Microcomputer power supplies should include a spike suppressor and I/O cables should be shielded to prevent transient noise coupling to the microprocessor I/O bus.

Power supply design can allow for a general system brownout, requiring sustained system operation at reduced voltage, but the effect of a power loss must also be considered. If the microcomputer control system is critical to plant operation, it must be protected by an uninterruptable power supply. The provision of backup power for system hardware should be considered as an integral part of the industrialized design process. Standard commercial power supplies may not provide the desired protection of microcomputer integrity in factory applications.

Solution Approach

The system designer must initially decide whether the application criteria are exacting enough to justify the use of other than commercial equipment and, having decided in the affirmative, whether a full military grade system is mandatory. For a typical process control application the range of choices is small, and may result in the decision to build a special purpose microcomputer system and to develop special purpose software for it. In the past, the cost of this type of development may have eliminated the justification for the computer control function. In order to keep development costs within reasonable bounds, the system should be software compatible with an existing commercial grade microcomputer. Thus, initial development of the application software can begin in parallel with the hardware design instead of waiting for delivery of a special purpose microprocessor.

The decision as to the type and method of the approach having been made, the process control system can be designed in a top-down approach. It was decided to duplicate the Intel iSBC 80/10A functions in a ruggedized design and to offer the full range of system building blocks that support the single-board microcomputer, augmented as required by a customized memory product line.

The SECS 80/10A illustrates a typical severe environment design (Fig 2, bottom). The upper surface is a 0.062″ (0.157-cm) aluminum heat sink integrally bonded to a PC board. The heat sink serves as a structural support for the circuit card assembly and as the heat conduction medium. The clamping mechanism, mounted on the rear of the board, clamps the heat sink directly to the thermal transfer surface.

Despite the stiffening effect of the bonded assembly, analysis showed that the board would flex significantly in the long [9″ (23-cm)] dimension. Two stiffening bars of 0.25 x 0.25″ (0.63 x 0.63-cm) aluminum are dip brazed to the heat sink, keeping total deflection under shock and vibration below 0.040″ (0.102 cm).

A NAFI fork and blade connector on the bottom edge provides integrity of connection through the 20 G

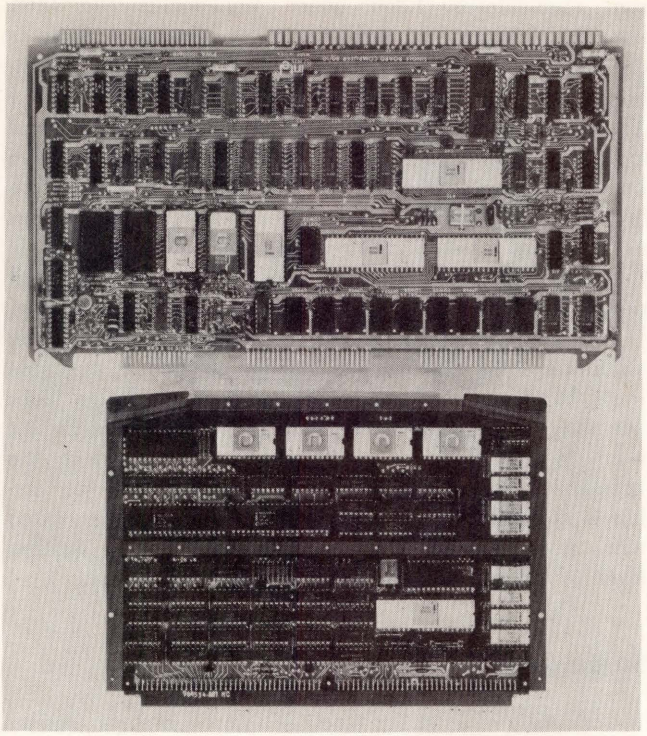


Fig 2 Two versions of 80/10A microcomputer. Intel's iSBC 80/10A single-board microcomputer for commercial applications is top board. EMM/SESCO's SECS 80/10A board (bottom) illustrates severe environment design process. Upper surface is 0.062″ aluminum heat sink integrally bonded to PC board. Heat sink acts as structural support for circuit card assembly and as heat conduction medium. Fork and blade connector on bottom edge provides integrity of connection

level. The connector is keyed with D style guide pins that permit blind mating of the card assembly into a specific position. The board is held in place by a captive, wedge-lock clamping mechanism riveted to the aluminum heat sink on each 6″ (15-cm) edge. Since the connector has 150 pins, each with an insertion force of 4 oz (28 g)/pin, two cam-action ejectors assembled into the heat sink on the upper edge aid in removal.

All system cards are assembled using the same basic mechanical design shown for the SECS 80/10A. Keying orientation of the connector pins is the only prime mechanical variable. Wherever possible, configuration options, such as memory starting address, have been implemented on the rear panel connector for optimum flexibility. Where this is not feasible, wirewrap terminals or turrets are provided on the board itself.

The system assembly in Fig 3 illustrates the method of mounting the cards on a backplane assembly while rigidly clamping the cards into a dip-brazed chassis assembly for optimum heat flow. Overall temperature rise from the thermal wall to the card heat sink is less than 5 °C for typical card dissipations of 20 W. The chassis will accommodate six cards or four cards and a power supply. The power supply occupies two card spaces and is located near the side of the chassis for optimum thermal transfer. Overall temperature rise from the edge of the chassis to the heat mounting flange of the power supply is less than 4 °C at full power dissipation of approximately 40 W.

The power supply is clamped into the chassis to provide shock and vibration support along both short edges. In order to meet worldwide power standards, it is designed to operate at frequencies from 43 to 420 Hz, with either 115 or 220 Vac. A 28 Vdc version fits in the same space affording further flexibility.

Fig 4 shows the final hardware for a full configuration system, without forced air cooling and with the top cover removed. The cards have a common outline and mounting dimension of 6 x 9″ (15 x 23 cm), capable of mounting on 0.625″ (1.587-cm) centers. The chassis shown meets the ½ Air Transport Rack (ATR) mounting dimensions and weighs 14 lb (6.4 kg).

Thermal Design

System cooling is achieved at the side walls of the chassis, totally avoiding interaction between the components and the surrounding environment. The cards are clamped to transverse thermal plates. Components within each card mount directly on an aluminum heat sink, which, in turn, is rigidly clamped to the thermal plate. Depending on the thermal load within the chassis

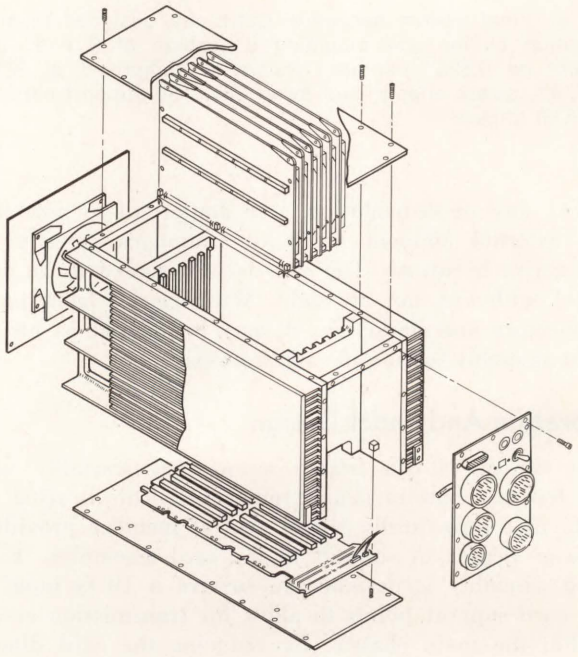


Fig 3 Microcomputer system assembly. ¾ ATR chassis assembly allows maximum thermal efficiency. ½ ATR sizing and other options are available depending on cooling required

and the final system mounting configuration, heat transfer from the side walls may be augmented in several ways: the system can be mounted in a ½ ATR mechanical mounting assembly as shown in Fig 4, the side walls may be modified by adding vertically oriented fin stock to improve thermal transfer, or the chassis may be modified by adding horizontally oriented heat fins and a shrouded fan assembly for maximum thermal efficiency as shown in Fig 3.

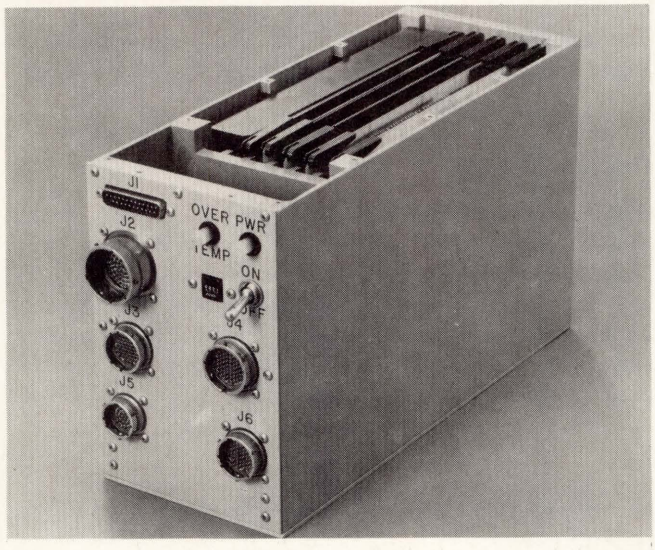


Fig 4 Final system hardware. Cards are designed to meet common outline and mounting dimension of 6 x 9″ and mount on 0.625″ centers. System is comprised of SECS 80/10A, power supply, and three SECS 80 support cards in ½ ATR chassis

For any implementation, it is important to note that the external ambient air never impinges directly on the active hardware. The chassis is designed to be dust proof, although not air tight. With special front panel connectors and gasketing, it may be offered as an air tight assembly for specific applications.

Vibration And Shock Design

The chassis is dip brazed as a total assembly with the top and bottom panels removable. This brazing results in a structurally sound central member providing a large degree of support to the card assemblies. Each card assembly is designed to survive a 10 G input at the card support points to allow for transmission effects within the main chassis. By reducing the card dimensions from Intel's 12 x 6.75″ (30 x 17.15 cm) to the ATR-compatible 9 x 6″ (23 x 15-cm) size, board deflections are maintained under 0.040″ (0.102 cm), resulting in a chassis capable of performing through 15 G, 11 ms shock and 10 G vibration from 5 Hz to 2 kHz.

Board Design

Fig 2 dramatizes the outstanding differences of the same microcomputer design for commercial and ruggedized applications. Each board implements the Intel iSBC 80/10A single board computer. Intel's version is the top board. In the rugged design, bottom board, board size has been reduced from 12 x 6.75″ (30 x 17.14-cm) to the 6 x 9″ (15 x 23-cm) outline and mounting dimension, and board edge connectors have been eliminated. Instead, the 48 parallel I/O lines are brought out from the integral connector on the bottom of the card assembly. The connector is a NAFI style fork and blade connector, proven through the full range of environment expected in the chassis assembly.

The chip mounting technique used is a bond to an aluminum heat sink that is rigidly secured to the side walls by a ramp clamp. The commercial design does not rely on conductive cooling, and therefore does not need to be clamped at the edges. To protect the ruggedized board assemblies from the effects of airborne contaminants and humidity, the board is coated with a clear polyurethane conformal coat, a further level of protection over commercial grade parts.

Summary

Introduction of existing, modular microcomputer systems into severe environments has resulted in a reduction of major problems besetting the systems design engineer. The environment is kept at bay by constructive application of test results obtained during costly military development, while system development continues, in parallel, using laboratory level, commercially available modules. This combination of practical commercial design with techniques developed for the full range of military environments allows immediate application of system designs to the process control industry under severe environmental conditions, realizing designs that were previously considered too failure-prone or costly to achieve.



Don Ballantyne is systems design manager at EMM/SESCO, responsible for a variety of military and ruggedized system design activities. He has designed core memory systems for full space environments and semiconductor systems to survive shock and vibration requirements of shipborne systems. He received a BSEE degree from the University of Glasgow, and an MBA degree from Pepperdine University.

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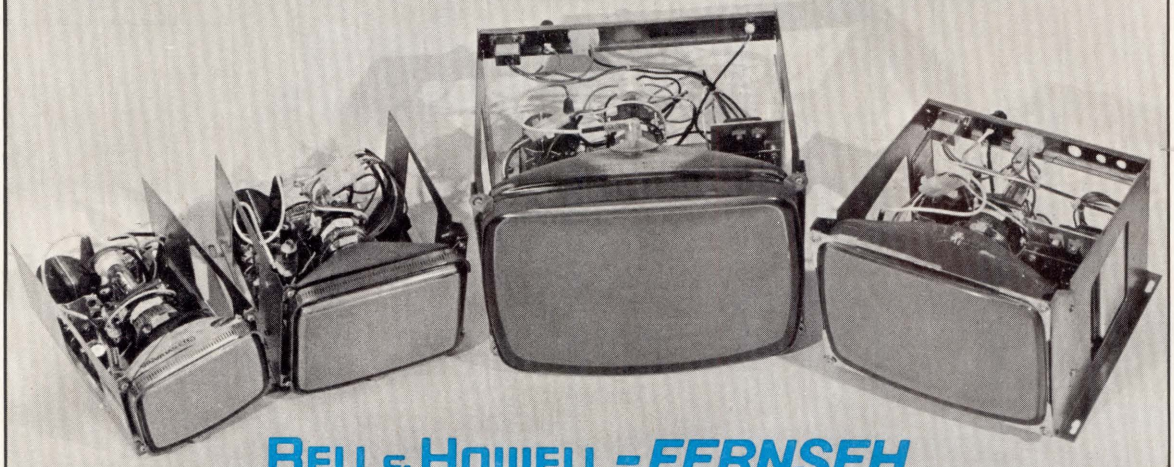
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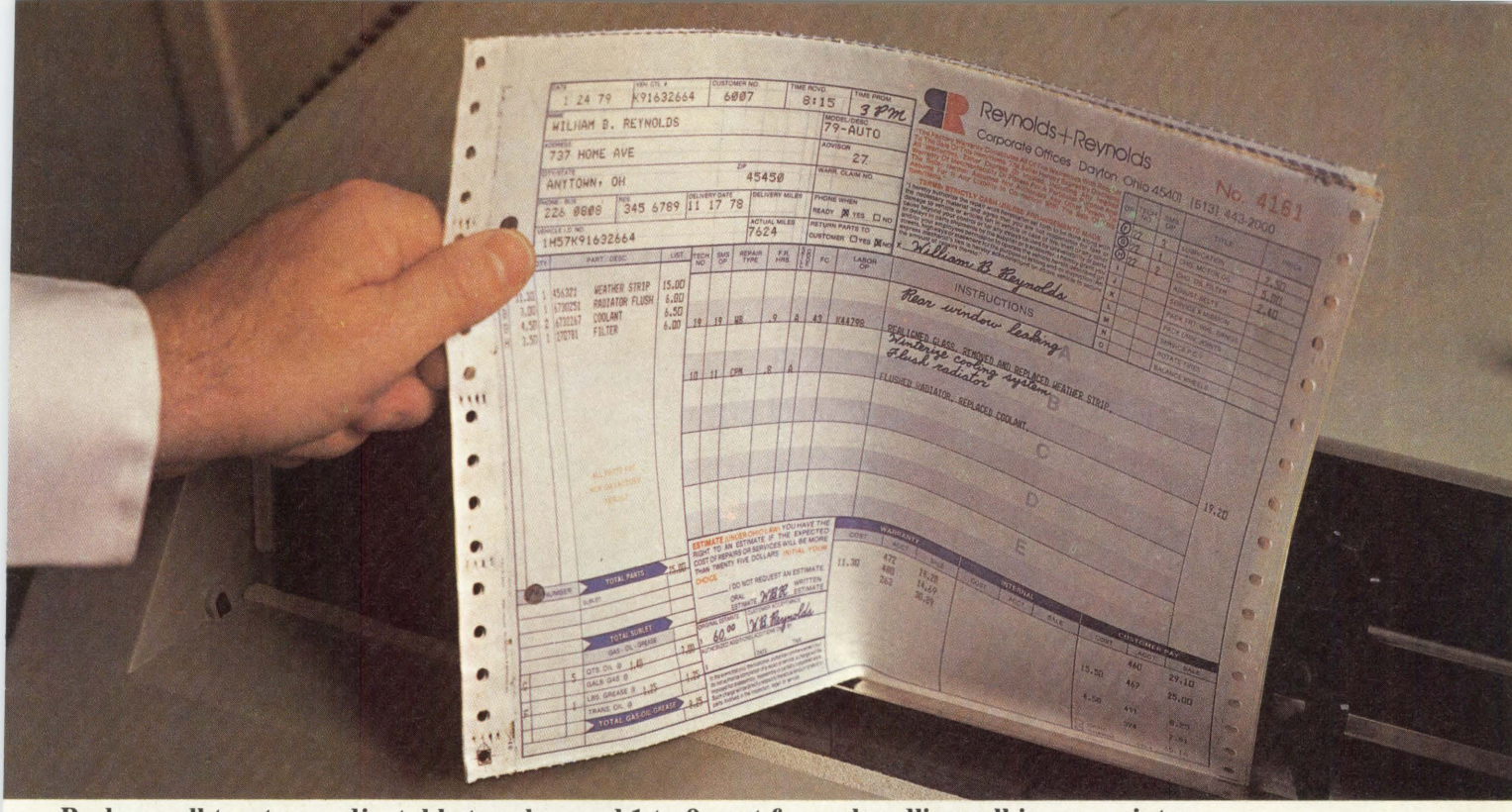
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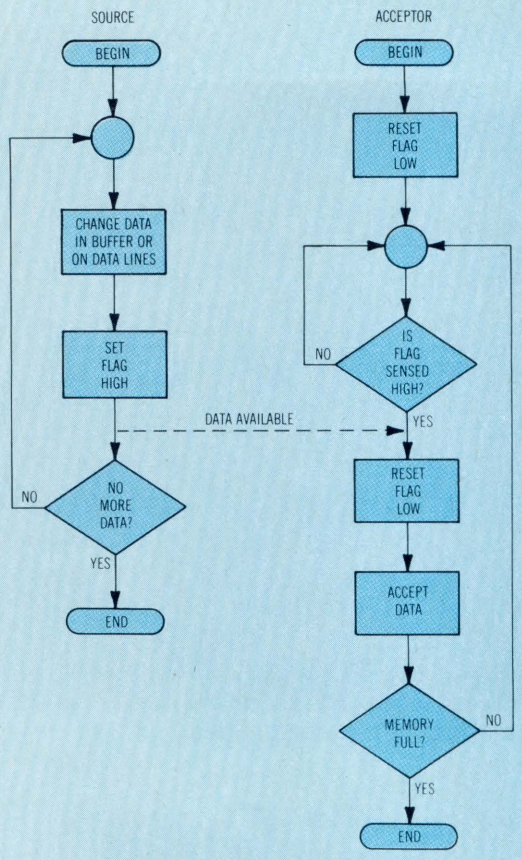


Fig 1 Flowcharts for source and acceptor. Single flag, which communicates only with microcomputer, indicates, when in high state, that new data are available

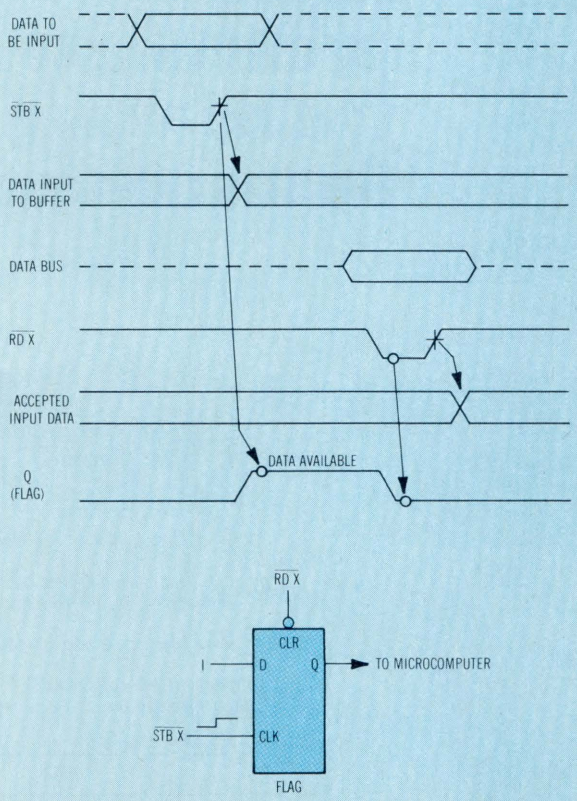


Fig 2 Conditional input with flag and buffer. Timing diagrams demonstrate sequence of timing signals and data transfers for microcomputer input using flag shown

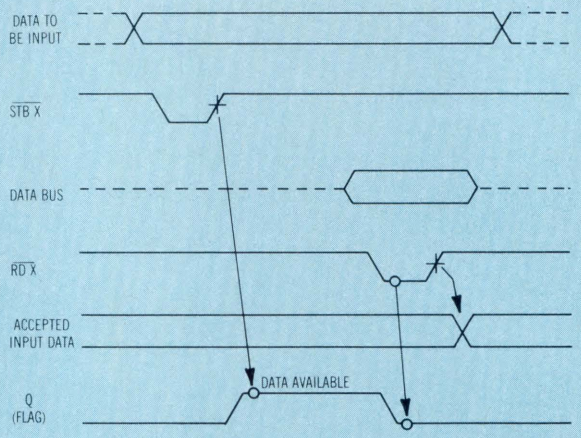


Fig 3 Conditional input with flag and no buffer. Timing diagrams show sequence of timing signals and data transfers for microcomputer input using flag shown in Fig 2

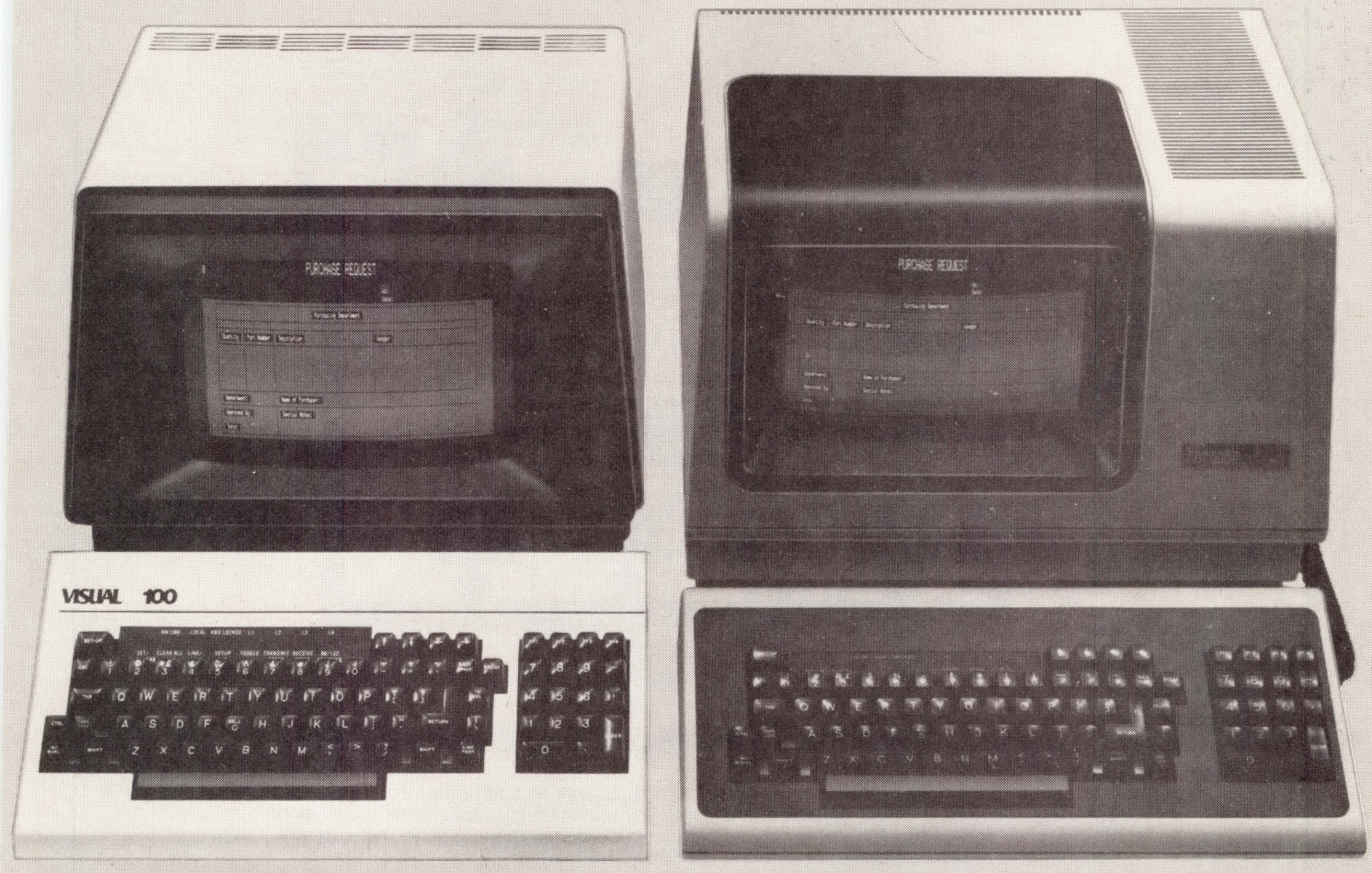
tested (polled loop, polled interrupt, vectored interrupt, etc) and the importance of input device X relative to other microcomputer tasks, the calculated repetition rate may be low or high. Careful programming may be required to make certain that input data are not lost. On the other hand, it may not be necessary to input every new data point. Only periodic data input, where the period is determined by software or by a realtime clock, may be required.

Timing diagrams in Fig 3 portray the situation when a flag, but not an input buffer, is present. Data to be input must be stable for a substantially longer time than that shown in Fig 2. The sequence of events in Fig 3 can be summarized as follows: the input device supplies new input data, the $\overline{\text{STB X}}$ pulse sets the flag and, after a period of time, the microcomputer detects the availability of new data, enables the data bus, and finally generates an $\overline{\text{RD X}}$ pulse that resets the flag and inputs the new data to the microcomputer. This technique is widely used with "slow" input devices (500 bytes/s or less) that have latched output data and with which data input timing is not critical. Counter/timers are examples of such devices. The use of the flag permits the microcomputer (acceptor) to ignore the input device (source) for as long as the flag is low (logic 0). Such a characteristic frees the microcomputer to perform other processing tasks while it awaits new input data.

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2. P. R. Rony, "Interfacing Fundamentals: Conditional I/O Using a Semaphore," *Computer Design*, Apr 1980, pp 166-167

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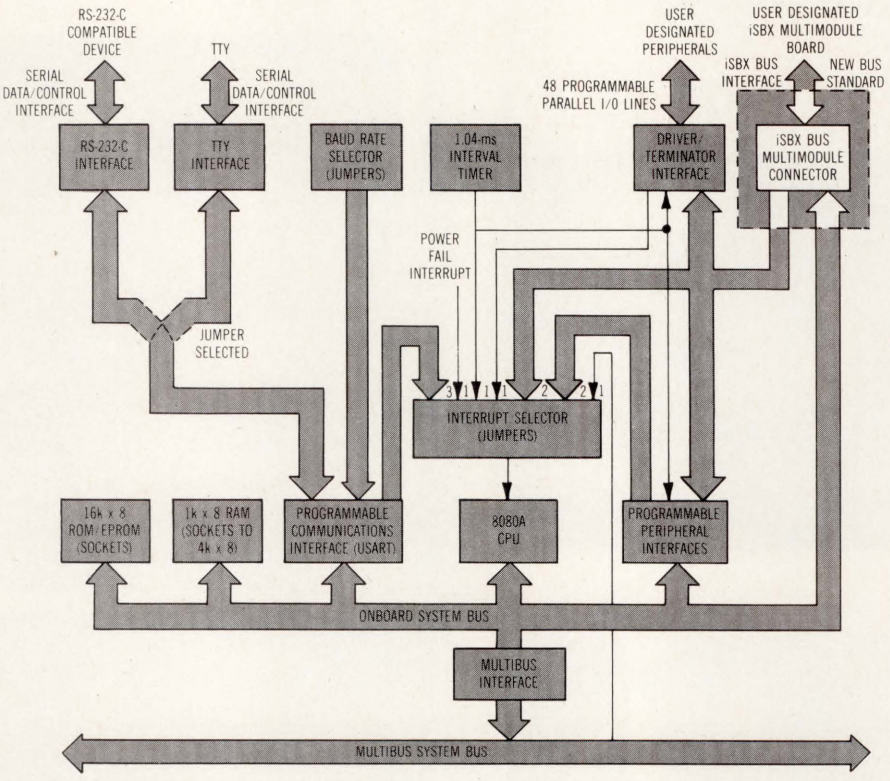
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Alterations to memory of Intel's iSBC 80/10A board, as well as addition of iSBX bus interface, has resulted in iSBC 80/10B board. Onboard expansion is done with small iSBX Multimodule boards that extend serial and parallel I/O, and add floating point math, permitting users to customize board design in a cost-effective manner

Incremental expansion of single-board computers is the concept behind the iSBX™ bus which supports the addition of iSBX Multimodule™ plug-in boards. Upward compatible with the 80/10A version, the iSBC 80/10B is expandable in multiple directions, meeting EPROM, RAM, and I/O needs. EPROM/ROM can increase from 1k to 16k bytes with four types of devices; 1k of RAM, which is included, may extend up to 4k using 2114A-5 1k x 4 static RAMs in sockets provided on the board.

Other enhancements are an onboard timer, a RAM power-fail control for battery backup, a 25% power savings to 13.0 W, and a strappable ROM disable to permit RAM overlay of ROM addresses during debug.

The TTL compatible iSBX bus interface, included with the global Multibus, accepts plug-in modules. Three iSBX boards add 8-bit serial and parallel I/O and math directly onboard; boards can be cost-effectively adapted to new technology, while readily meeting greater applications with the exact function required. Two standard Multimodule board sizes are 2.85 x 3.7″ (7.24 x 9.4 cm) single width and 2.85 x 7.5″ (7.24 x 19.1 cm) double width.

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COMPUTERS, ELEMENTS, AND SYSTEMS

The iSBX 351 offers serial I/O expansion using an 8251A USART. With an interface identical to the SBC standard, the module is compatible with the RS-232-C and the RS-449/422 standard. An onboard programmable baud rate generator provides 18.75k to 64k baud. Two programmable 16-bit BCD and binary timers offer incremental timing of 1.63 to 427 μs, or up to 7.8 h by cascading both timers. The USART or timers generate interrupts to the base board.

Final module iSBX 332 uses the 8232 floating point processor. Compatible with proposed IEEE and Intel formats, the unit supplies single (32-bit) or double (64-bit) precision math: add, subtract, multiply, and divide. Other features are end of operation and error interrupts to the host processor, as well as software reset control. Commands run independently of the host board for high speed concurrent math processing.

Intel Corp, 5200 NE Elam Young Pkwy, Hillsboro, OR 97123, has also arranged for users to implement specialized requirements on the iSBX bus with the custom designed 36-pin male connector. The iSBX 960-5 consists of five male connectors that have passed stringent reliability testing. It mates directly with the female connector on the 80/10B, allowing custom applications to use the power of the iSBX bus.

The board accepts the usual Multibus system expansion capabilities and is compatible with the company's future 8- and 16-bit single-board computers. It accepts the existing PL/M-80, FORTRAN-80, and BASIC-80 programming languages; furthermore, it operates with the RMX/80 executive, containing all major realtime facilities.
Circle 465 on Inquiry Card

Non-returnable Capacitive Keyboards

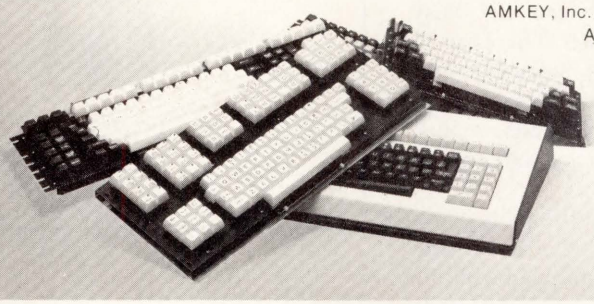
Practically Speaking, that is!

When AMKEY ships a keyboard, it's likely that we'll never see it again. And that's because our products pass the most stringent and exacting quality controls. Our QC program assures durable characteristics in every keyboard we sell. For example, a 10Kv static charge won't disturb the strobing process. Steel top plate construction prevents warping under most conditions.

To our customers, it all adds up to uninterrupted operation. Reliable Capacitive Keyboards — We've been delivering them for years.

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CIRCLE 108 ON INQUIRY CARD

Operating System Simplifies 8086 Software Development

In a related announcement, Intel's OEM Microcomputer Systems Div introduced the RMX/86, a realtime modular operating system for the 8086 16-bit microprocessor, that permits OEMs to develop multiprogramming, multitasking systems. It accommodates a large range of peripheral controllers. While similar to the RMX/80, the /86 features an altered architecture and added features to complement the 8086. The system's functions are like the 8086 instruction set operators which manipulate operands; they handle such objects as jobs and memory segments. To add custom operating system functions, the user can write operators and create objects.

Residing in EPROM, ROM, or on disc, the system is actually a library of functions to be implemented with user developed tasks or programs in order to produce a custom product. Components are a nucleus, with scheduler, intertask communication, and interrupt handling, plus optional system services such as file systems. Realtime facilities include interprogram communication, critical section and free space managers, and an exception handler. Also featured are a priority oriented scheduler and error handling.

The second level, a device independent I/O system, provides an interface for the application programs to communicate with the I/O device. Included are a random access device driver interface, automatic buffering, read ahead, write behind, and an application loader for both absolute and relocatable code. A single-density diskette and hard disc drivers are provided.

The debugging system allows memory examination and modification, execution breakpoints by task, and capability to monitor stack overflow. Two other capabilities to be announced later are the human interface and application loader. Offering extensive user console services, the former has a command line interpreter, utility commands, multiple command sources, and dynamic addition/deletion of commands. The loader will provide synchronous and asynchronous loading of absolute and relocatable code.

See at Booth 1354

Circle 466 on Inquiry Card

Storage Module Drive Controller Supports 300M Bytes On LSI-11 Bus

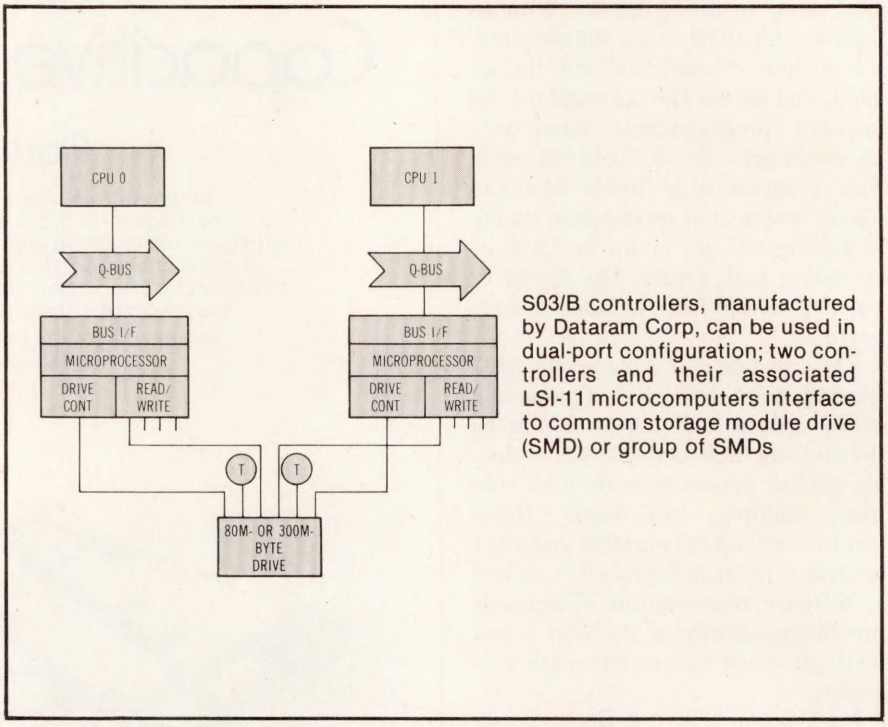
Microprocessor based S03/B disc controller for the Digital Equipment Corp LSI-11 series microcomputers emulates the functions and operations of the DEC RK611 controller and attached RK07 disc drives. Operating under the RT-11 and RSX-11M operating systems, the device is functionally equivalent to a DEC RK07 subsystem of the same capacity. Up to four CDC 80M-byte 9762 SMD and 300M-byte 9766 SMD or equivalent Ampex, Ball, and Century Data Systems drives can be daisy chained on the controller. There are 16 registers visible to software and emulated by the controller to communicate control commands, status, data error conditions, and maintenance information.

Dual-port capability enables two controllers to access one or more common discs which are equipped with the dual-port option. Error correcting code logic consists of 32-bit ECC for data, allowing correction for a single 11-bit error burst, and 16-bit cyclic redundancy check for header error detection.

A 2k-byte bipolar RAM provides a 4-sector data buffer that eliminates the possiblity of data late errors and permits the controller to be assigned a low bus priority level. Furthermore, Dataram Corp, Princeton-Hightstown Rd, Cranbury, NJ 08512, has included internal self-test with LED displays. The controller's microcode includes an automatic bootstrap.

Packaging of the controller consists of two standard DEC quad boards joined together in a single asembly via AMP mod I pins. Interfacing directly to the standard Q-Bus of the LSI-11, the controller plugs into two quad slots and completely conforms to Q-Bus protocol. The bus drivers and receivers present one unit load on all signal lines and are identical to those used by DEC. Power required is 5.0 Vdc at 9.0 A and −15.0 Vdc at 0.7 A. Single-quantity price is $5400.

Circle 467 on Inquiry Card



S03/B controllers, manufactured by Dataram Corp, can be used in dual-port configuration; two controllers and their associated LSI-11 microcomputers interface to common storage module drive (SMD) or group of SMDs

Microcomputer Printer Allows Users To Copy Graphics And Tailor Formats

Acting as a hardcopy counterpart of a video monitor, the Silentype™ thermal printer for the Apple II makes paper copies of any text or graphics that the computer can display. The user has access to the processor that drives the printer, controlling printing modes, formats, and intensitities.

The silent printer uses a 7-dot thick-film printing element to produce 5 x 7 dot characters and graphics on standard thermal paper. Resolution is 60 dots/in (24/cm). Powered directly by the computer, the unit prints up to 80 char/line on 8.5″ (21.6-cm) wide roll-fed paper. Apple Computer, Inc, 10260 Bandley Dr, Cupertino, CA 95051, has suggested $595 as the retail price, including the interface.

Typical graphics printing rate is 1 min/screen in bidirectional mode and 1½ min in unidirectional mode at a printing speed of up to 240 dot columns/s. Text mode rate is a maximum of 40 char/s.

The 2k bytes of firmware on the interface card provides the user with the flexibility to change parameters. With a few keystrokes, the user can set left and right margin locations, between line spacing in 1/6-line increments, length of paper advanced when form-feed command is received, and one of eight intensity values which controls dot darkness for light or boldface printing. Unidirectional printing can be selected for graphics, or bidirectional printing for optimally handling the 96 upper and lower case ASCII characters. Other capabilities are simultaneous printing and display, printing either of two high resolution display pages from Apple II memory, and printing displays in normal video or inverse modes, which improves readability of such graphics as curves, diagrams, and maps.

See at Booth 536

Circle 468 on Inquiry Card

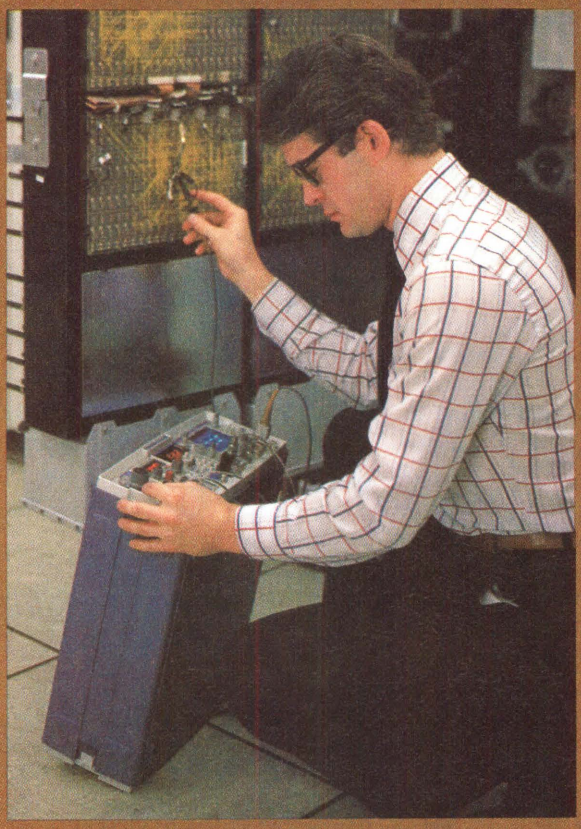
TM 500 gets up and goes!

A test and measurement system that lets you take what you want where you want.

When it comes to testing on the fly, TM 500 gives you two ways to go:

For long-range portability, there's the TM 515 Travel Lab Mainframe. It holds up to five instrument modules that can be used either independently or in combination through a rear interface board. And with nearly 40 different TM 500 plug-in instruments to choose from, you can assemble exactly the test array your travels require. From DMMs to oscilloscopes to generators.

With its snap-on covers, the TM 515 Travel Lab is attractive as well as durable. It fits easily under most airline seats and weighs only about 30 lbs. fully loaded with plug-ins.



For trips next door or down the hall, there's the Model 3 Cart. With a Tektronix Oscilloscope on top, up to two TM 500 Mainframes can fit on the lower decks. A large accessory drawer at the base lets you store all your odds and ends. And four permanent power outlets are joined to a single 15-foot line cord.

To find out more about TM 500, contact your local Tektronix Field Office, or write Tektronix, Inc.

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MICRO DATA STACK
COMPUTERS, ELEMENTS, AND SYSTEMS

Signal Conditioning of Data Acquisition Card Accepts Analog Inputs

Frontend analog signal conditioning combines with an A-D converter to create the series 6800 industrial data acquisition subsystem which directly accepts inputs of high level analog signals, process currents, and millivolt and thermocouple signals. The unit is suited for closed loop control applications in which analog signals are digitized with up to 250 V of isolation above ground.

Electrically and mechanically compatible with the Motorola EXORciser bus characteristics, the cards slide directly into the card slots of the microprocessor chassis. Each subsystem consists of at least one 6810 A-D base card with one or more optional expander cards. Subsystem design permits field expansion of up to 256 channels of mixed signal types for each base card used.

Communication with the Motorola EXORciser is over its address and data buses using memory mapped I/O. The 6810 base card uses a 16-byte contiguous block of memory address to communicate with the bus. This 16-byte communications area can be placed on an even 16-byte boundary anywhere in the 65k-byte addressing range.

Components featured on the card are a 12-bit A-D converter with programmable offset and gain, bus interface and control logic, circuitry to accept analog inputs from expander cards, and a socket to accept a P/ROM personality module that describes the inputs to that card. Provisions are included for 16 or 32 single-ended (8 or 16 differential) high level analog inputs and mounting pads for precision resistors to transform process current inputs to voltage inputs.

Each card accommodates added analog inputs of various types through the use of expander cards. Analog gain and buffering circuitry reduces loading and noise effects when several expanders are used. Other features are A-D conversion timing, an auto zero feature, and provision for a P/ROM. Each expander can have the channel numbers set on that card; these addresses are set on even 16-channel boundaries.

Circuits on these cards condition and amplify the analog input signals for the best transmission from each expander card to the base card which contains the programmable gain amplifier. The expanders are connected to the base via ribbon cables.

Any combination of expander cards may be used to match the specific inputs to a system. The subsystem design implemented by Acromag, Inc, 30765 Wixom Rd, Wixom, MI 48096, allows this expansion without reconfiguring the base and existing expander cards.

The 6820 high level expander characteristics include 32 single-ended or 16 differential inputs, inputs protected against high voltage transients, and 20k channel conversions/s. Input ranges are 0 to 1 V, ±1 V, 0 to 10 V, and 1 to 5 V.

Features of the 6830 process current expander are 8 or 16 isolated channels, 250-V isolation, and 10k channel conversions/s. Inputs are accepted over a 4- to 20-mA or 10- to 50-mA range.

The third card is the 6840 millivolt/thermocouple expander with flying capacitor design and temperature reference circuitry. A panel for thermocouple inputs features a temperature reference mounted close to the screw terminals; this panel improves thermocouple measurement accuracy, permitting the system to be independent of the thermocouple type used. There are 8 or 16 isolated channels, 250-V isolation, sensor failure detection, and 200 channel conversions/s. Full-scale ranges are 15, 30, 60, and 150 mV.

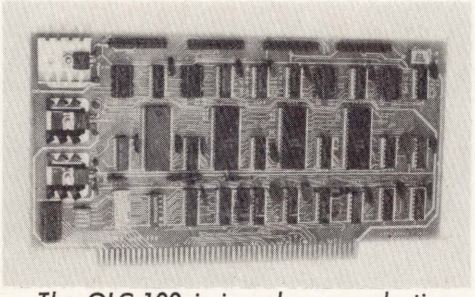
Every analog input signal connects directly to a termination panel which can be mounted remotely from the cards. Industrial screw terminals are used for field wiring termination. Stacking of termination panels conserves space.

Circle 469 on Inquiry Card

SERIOUS ABOUT **DATA COMMUNICATIONS?**

IF YOU USE THE S100 BUS, THE QLC-100 IS FOR YOU!

The QLC-100 offers 4 RS232 ports on a single S100 board, and these are full function ports with complete modem control.



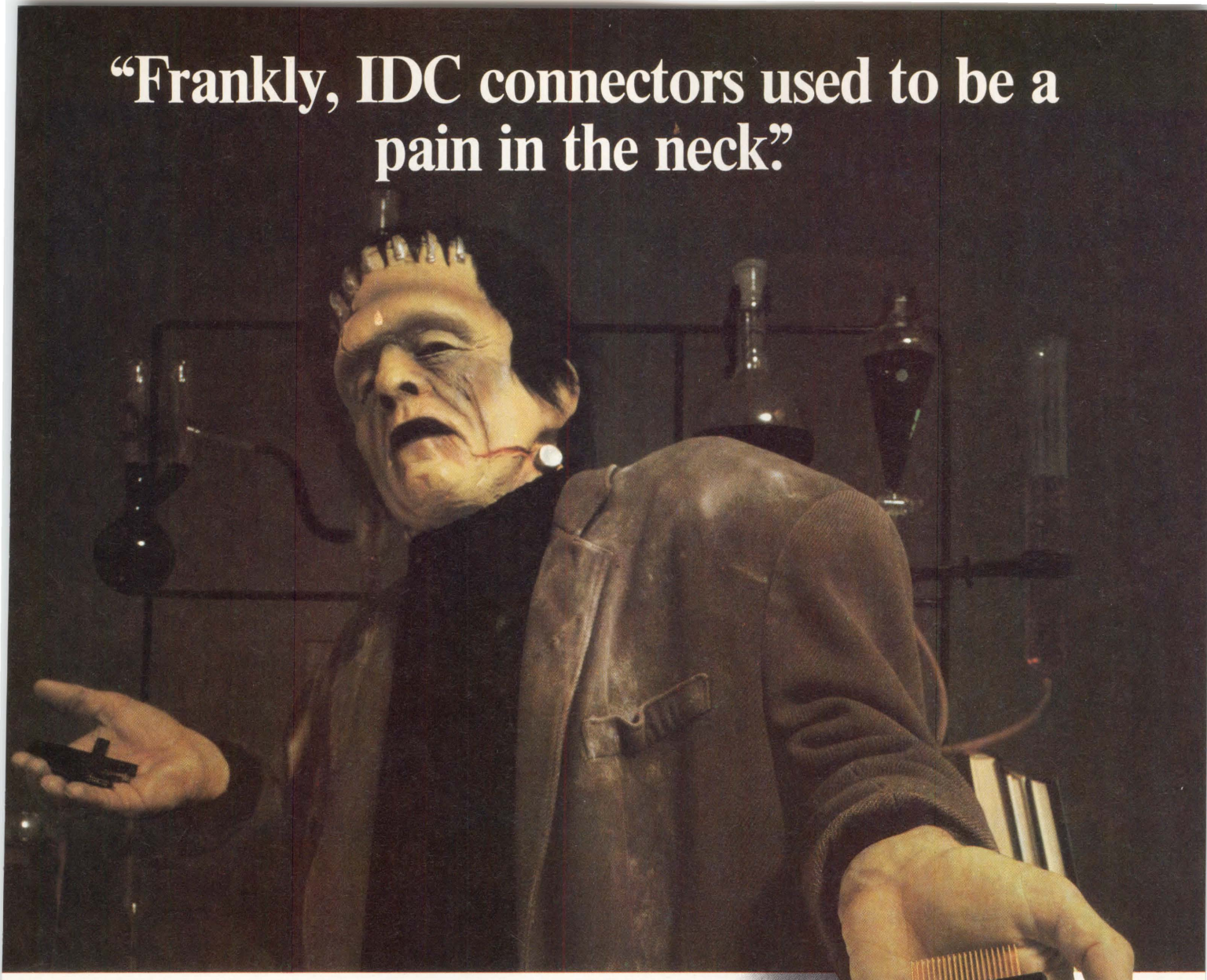
The QLC-100 is in volume production

To order or for more information, call or write
The *Thomas* Engineering Co.
1581 Whitman Road
Concord, California 94518
Telephone (415) 671-7018

- **PRICE: $459.00**
- **Cables: $18.00 each**
- Dealer & Quantity Inquiries Invited

FEATURES:
- **Synchronous or asynchronous using Signetics 2651 PCI**
- **Independently programmable baud rate selection**
- **16 speeds from 50 to 19,200 baud asynchronous, or externally clocked**
- **Up to 800K baud synchronous**
- **Similar to 8251 type I-O**
- **Supports IBM Bi-Synch formats**
- **Clocks can be trasmitted off board to users equipment**
- **I-O mode or memory mapped at any 16 byte boundary**
- **Flexible interrupt system**
- **All channels completely independent of each other**
- **On board crystal clock for baud rate generation**

"Frankly, IDC connectors used to be a pain in the neck."



"My problems were monstrous.

When I could find the connectors I needed, I would have to go digging around for the cable. If the price was right, the products weren't. And on and on, eon after eon.

Until one day my doctor suggested Spectra-Strip.

Of course! They've been making flat cable longer than anybody, so they would have to know how to make ends meet!

They do, and now I get all my IDC receptacles, headers, DIP plugs and sockets, PCB transitions and card-edge connectors from a single, reliable source: Spectra-Strip.

When things get really busy at the lab, I even have them or one of their value-added distributors provide completely terminated and tested jumpers and custom assemblies.

Their products are just what the doctor ordered, their Q.C. has real teeth in it, and their prices never put the bite on my budget.

For the name and number of your nearest distributor or rep, write Spectra-Strip, 7100 Lampson Avenue, Garden Grove, CA 92642, telephone (714) 892-3361. In the East, call (203) 281-3200.

And tell them Frank sent you."

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SPECTRA-STRIP An Elco Company

When you're down to the wire.

The Ball Family Plan



Winchester. The new Ball Centennial Series offers more reliable Winchester drives with lower parts count, simplified head/disk assemblies, and the precision of true linear motor actuators. Our first two Winchester 14-inch drives offer capacities of 90 and 158 megabytes. Future upgrades will double those capacities to help you meet growing storage requirements.

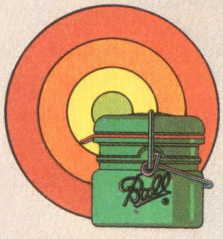
Removable. Ball backs up Winchester with a compatible family of SMD/Trident-type removable storage modules in 50, 80, 100 and 160 megabyte capacities. All moving parts in actuator and disk pack are sealed to maintain a clean environment. Constant voltage power supply prevents premature component failures and recording errors produced by line variations. Deck plate, logic and power chassis butterfly open from top and sides for faster servicing.

Controllers. Ball controllers for PDP-11, Nova and other popular computers complete your data storage system. Each controller directs up to FOUR Ball Winchester or SMD-type drives in any combination. Controller features include ECC, overlapped and implied seeks, sector interleaving, multiple sector transfers, offset and strobe, bad sector flagging, and write protect.

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MICRO DATA STACK
COMPUTERS, ELEMENTS, AND SYSTEMS

Upgrade Package Alters Development System To Use Operating System

Disc file management and operating system capabilities that facilitate the development of software and hardware for the RCA 1800 family can be added to the CDP18S005 COSMAC development system equipped with a floppy disc system and minimum of 12k bytes of RAM. The CDP18S837 upgrade package of hardware, firmware, and software converts the system to a functional level that is equivalent to the COSMAC DOS development system (CDP18S007).

Package components are 16k bytes of static CMOS RAM, a UART terminal interface module, replacement P/ROM for the utility program, CDOS system diskette, and instruction manuals. To incorporate this software into the development systems, the necessary modifications are installation of memory modules, extraction of the terminal interface module, insertion of the UART module, and addition of the P/ROM containing utility program UT21. Standard cables supplied with the development and floppy disc systems can handle interconnections between system components. Programs developed for earlier CDS systems which do not use disc I/O routines can be upgraded to run under CDOS by use of a CDOS copy routine.

The CDOS disc file management and operating system enhances program development. Users have rapid access to files without concern for file size or disc space allocations, because CDOS references files by name rather than track number. Improved protection guards against inadvertent file damage. Faster loading and reduced storage are obtained since CDOS loads binary files. Assembler outputs can be directed to a disc file with symbol table and references either aded or suppressed.

RCA/Solid State Div, Rt 202, Somerville, NJ 08876, suggests two optional accessories for use with the enhanced system. The COSMAC Micromonitor (CDP18S030) permits in-circuit debugging in realtime of both hardware and software. It is specifically recommended for development of programs that are more than 1k bytes long. A hardware/software P/ROM programmer package, CDP18S480, allows the user to program Intel 2704, 2708, 2758, 2716, and equivalent P/ROMs. It additionally reads, but will not program, 1702 type P/ROMs, thereby coping these P/ROMs onto others.

Installation of the upgrade package also gives the user access to optional software. The disc based BASIC 1 compiler/interpreter, CDP18S834, provides rapid program development. Beginning programmers learn the language easily; addition of machine language routines extend the language indefinitely. Three other packages are binary fixed point (CDP18S826) and floating point (CDP18S827) arithmetic subroutines, and COSMAC Micromonitor Operating System (MOPS).

Circle 470 on Inquiry Card

Bit - Slice
NIGHTMARES

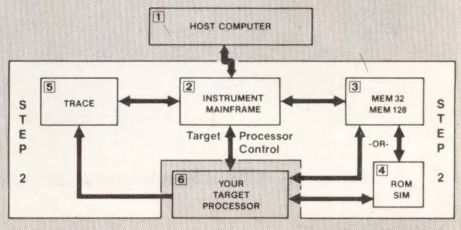
Microprogramming Nightmares . . . That STEP-2 Has Banished

NIGHTMARE #		NIGHTMARE COST*
#1	We only used up $50,000 worth of PROM's during development. What do you mean, Production is short of them?	$50,000 + Late Product
#2	Our bit-slice system almost works.	Bankruptcy?
#3	Real-time testing wasn't important. Of course Charlie's still "tightening" code.	Maintainability + $100,000?
#4	Charlie's home built simulator didn't break down until after he left for Germany.	Project Delay + $32,000?
#5	How can they scrap the project? We have only been debugging for six months.	Market Share + $250,000?
#6	It is just another 2 hour assembly	Frustation

Get Rid Of Your Nightmare . . . Wake Up To STEP-2

Not just another bit-slice development system . . . a complete solution to your microcoding problems:
• Microcode development in-circuit • Real-time memory simulation
• Fast word-oriented microcode editing • Real-time trace of processor activity

STEP-2 surrounds your processor, giving you the flexibility needed to turn your nightmare into a sweet dream. With STEP-2, you spot a bug, track it, recode, kill it . . . and sleep nights.



1 Use **any** computer to develop microcode: STEP will provide the meta assembler if you need one. Advantages: less startup time—no new operating system to learn—faster code development—quicker assemblies, simultaneous hardware and software development—less cost using existing computer. No computer? In many cases STEP-2 *plus* a computer costs less than our nearest competitor!

2 STEP-2 is a standalone interactive development instrument with: integral CRT, keyboard, word oriented microcode editor, communications facility with upload/download routines, control port for target processor, reconfigurable memory, and simple, fast-learn command routines. All in the base price.

3 Real-time reconfigurable memory simulation from 8 to 192 bits. You configure STEP-2 array size for each new project. Choose from both memory families:
• MEM 32 for fast controller applications: depth to 2k, worst case access time to **36ns**
• MEM 128 for processing applications: depths to 48k, worst case access time to **50ns**
Bonus: STEP-2 handles one memory array or several, pipelined or not.

4 ROM simulation cable family allows you to plug into existing PROM sockets on any target processor.

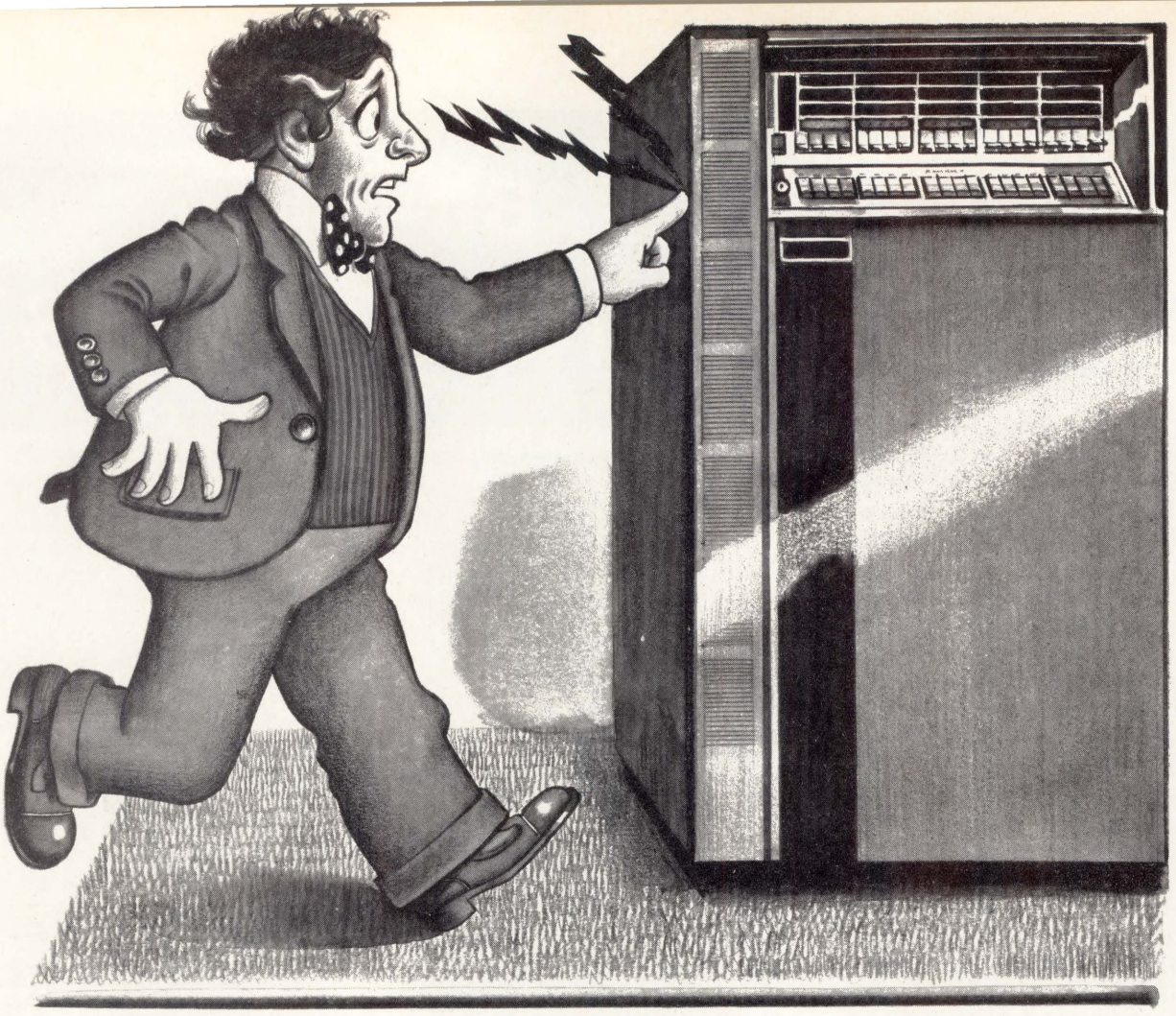
5 Real-time Trace for synchronous capture of processor states at cycle times to 90ns. A selection of triggering equations and modes from self-teaching menus simplify complex setups.

6 Your processor/controller under development is supported by STEP-2 *regardless* of configuration. Doubt it? Call Curtis at (408) 733-7837.

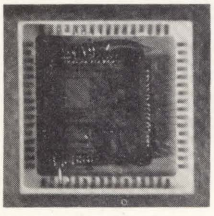
***Good equipment pays for itself. STEP-2 is priced from $4,950 to $49,500. Call STEP today for a quote.**

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CIRCLE 112 ON INQUIRY CARD



DESTROYING A CIRCUIT IS AS EASY AS WALKING ACROSS A CARPET



Acrylics, wools, silks and moving nylons in a computer room increase susceptibility to static charges. A few steps and a spark from body to computer cabinet is all it takes to produce a charge as high as 30,000 volts. And, if the cabinet and/or components are poorly grounded, the charge can be transmitted to components causing overloading and circuit malfunction.

Metex Shielding Provides Ideal Protection from Low Signal IC Overload

Metex shielding products such as Combo Strip® Gasketing, Xecote® Conductive Coating and Xecon® Conductive Elastomer protect your equipment by shielding it from this predatory energy...keeping it away from digital IC's and other vulnerable components.

Metex Products Protect Against Unwanted EMI/RFI Too

Viewing screens, air vents, cabinet slots and any other enclosure openings are access points for EMI/RFI energy. Easily picked up by sensitive components by induction, EMI/RFI radiation can cause distortion of low power signals and overloading of subsequent circuits. This may lead to IC degradation, or catastrophic failure.

Metex provides Shield-Vu® Shielded Windows of any size or shape, constructed of finely knitted wire fused between panes of acrylic or glass, that offer effective attenuation with over 90% visibility. We also make air intake and exhaust vents that permit free airflow but are almost totally opaque to EMI/RFI.

Available in configurations to meet your needs, Metex shielding products are produced to the most exacting demands, including France's CISPR, the German VDE and U.S. IEEE.

Protect your digital IC circuitry. Our staff of applications engineers will assist you now in finding solutions to your present and potential shielding problems. In the East call 201-287-0800, west of the Rockies call 213-320-8910. To write: 970 New Durham Road, Edison, N.J. 08817 or 20437 S. Western Avenue, Torrance, CA 90501

METEX
ELECTRONIC SHIELDING GROUP

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CIRCLE 113 ON INQUIRY CARD

Disc Drives Enhance Cost-Effectiveness Of Microcomputer Systems

Two models added to the CP/M compatible desktop microcomputer series by Quay Corp, PO Box 386, Freehold, NJ 07728, are the 500 and 520 systems. Based on the Z80 94F/MPS single-board computer, both units have 32k bytes of dynamic RAM expandable to 65k bytes, DMA based disc access, three counter/timers, RS-232-C or TTY serial port, and a Centronics compatible parallel line printer I/O with up to four 8-bit programmable ports. Dual ac convenience outlets accept peripherals. The CP/M (version 2.0) disc operating system has a P/ROM resident boot program.

Disc storage differentiates the two systems. Model 500 uses dual single-sided, double-density 5.25″ (13.34-cm) flexible disc drives which offer a formatted disc capacity of over 400k bytes. Model 520 implements dual 2-sided, double-density 5.25″ (13.34-cm) flexible disc drives for over 800k bytes of formatted disc capacity. Access times are 30 ms track to track and 370 ms average. Features of the DMA based controller are single/double density, multisector and multitrack transfers, data scan, and compare.

Several optional items are offered. Serial I/O expansion adds two RS-232-C ports with programmable baud rates. System expansion is handled by an S-100 bus adaptor. In addition, the flexible discs can expand up to four drives.

Circle 471 on Inquiry Card

Expandable Video Terminal Allows Users To Build Full μComputer

The VT103 terminal, an extension of the VT100, contains an LSI-11 microcomputer backplane for users to configure an LSI-11 system within the terminal's enclosure. The user adds the microcomputer and LSI-11 bus option modules to customize the unit for a specific application. The user also has to work out the communication scheme that permits the processor and terminal sections to communicate.

Containing the standard features of the VT100, the terminal adds the backplane assembly and upgraded 140-W power supply which is switch selectable between 115- and 230-V operation. Digital Equipment Corp, Maynard, MA 01754, is offering the basic VT103-AA model for $2990 and the VT103-BA with dual-drive DECtape II cartridge subsystem for $3890.

Circle 472 on Inquiry Card



CIRCLE 114 ON INQUIRY CARD

DS BRIEFS

Arithmetic Processor Unit Increases Program Execution Speed—Model 7811B hardware floating point unit uses the AMD9511 arithmetic processor to speed Applesoft II programs, allowing the Apple II to produce more sophisticated high resoltuion graphics. Introduced by California Computer Systems, 250 Caribbean Dr, Sunnyvale, CA 94086, it also increases the number of math functions available to the programmer. . . .**Pascal and Floppy Disc Drive Highlight Microcomputer**—Standalone Series 2000 consists of a double mini-floppy disc drive and controller, two high speed microprocessors, 64k bytes of dynamic RAM, boot ROM, 12" (30-cm) CRT, keyboard, and two serial ports. Software offered by Wave Mate, Inc, 18005 Adria Maru Lane, Carson, CA 90746, includes a disc operating system, Pascal compiler, full screen and character editor, and P-code interpreter. . . .**Designers of Multibus Compatible Devices Can Concentrate On Circuit Design With Prototype Board**—Eliminating the reconstruction of bus interface circuitry, the MB80 contains a general purpose slave interface combined with a universal prototyping layout that accommodates 14- to 40-pin sockets. Schneider Instrument Co, 8115 Camargo Rd, Madeira, OH 45243, designed the interface circuitry to include 14 socket mounted ICs.

Mainframe's Asymmetrical Card Spacing In Bus Handles Narrow and Wide Boards—Omega mainframe houses the PCM-12, a PDP-8 compatible microcomputer based on the 6100 microprocessor. Features installed by Pacific Cyber/Metrix, Inc, 6800 Sierra Ct, Dublin, CA 94566, are a tilt-up card cage with lock mechanism, bus structure with connectors for up to 18 plug-in cards, power supply, and pushbutton actuated front panel structure. . . . **Relocatable Disc Operating System Enhances File Manager and Text Editor**—RDOS runs on GenRad/Futuredata's (1615 W Century Blvd, Suite 1124, Los Angeles, CA 90045) 2300 standalone and 2301 network series development systems. The file manager includes a wild card facility, as well as disc verify and file verify commands; the text editor allows blocks of text to be moved, copied, or written out as separate files. . . .**STD-BUS 65k-Byte Dynamic RAM Offers Auto Refresh**—The 6.5 x 4.5" (16.5 x 11.4-cm) ST4203 for STD BUS environments operates at up to 4.0 MHz. Replacing four 16k static RAM cards, the board has a refresh controller permitting the processor to be synchronized to an external event. Applied Micro Technology, PO Box 3042, Tucson, AZ 85702, has equipped the board with memory expansion.

Cross Compiler Running On VAX System Produces Microcomputer Code—Cross compilers for the VAX-11/780 operating systems produce code for the Intel 8080, as well as the PDP-11, for use in emulation mode. Whitesmiths Ltd, POB 1132 Ansonia Sta, New York, NY 10023, announced it in conjunction with a C compiler for Western Electric's UNIX V32 and DEC's VMS operating systems. . . .**Extension of Hard Disc Systems Impact Small Microcomputers**—Model 7710 T,A,S adds 10M bytes of storage to TRS-80, Apple, and S-100 bus computers. The unit, from Lobo Drives, International, 935 Camino Del Sur, Goleta, CA 93017, includes an IMI 7710 Winchester technology disc drive, intelligent controller, power supply, interface, and software. . . .**ROM Loader Card Loads a 16k Program in Under 1 s**—RL990-1 allows rapid reloading of remote, standalone 990 processors. By activating Load on the front panel, the user transfers a program from EPROM to RAM. Developed by National Data Corp, Telecommunications Div, One National Data Plaza, Corporate Sq, Atlanta, GA 30301, the card features a watchdog timer circuit, a software readable hexadecimal switch, and four software programmable status LEDs.

Buffered Prototyping Board Is EXORciser Compatible—The unpopulated 9612, optimized for use with the 3M Scotchflex™ breadboard plug strip system permits the user to produce breadboards and low volume special purpose modules. An added feature incorporated by Creative Micro Systems, 11642-8 Knott Ave, Garden Grove, CA 92641, in the M6800 microprocessor bus compatible board is a prewired section that provides address decoding and data bus bufferings. . . .**Prepackaged Software Transforms Microcomputer Into Turnkey Business System**—Vector Graphic Inc, 31364 Via Colinas, Westlake Village, CA 91361, is including a multi-application bundled software package with its small business computer system. The software is comprised of five Peachtree general accounting applications packages as well as Microsoft BASIC-80.

Generic Module Allows Programming of 2732A EPROM—The PM9074 personality module for series 90 P/ROM programmers also accommodates other HMOS EPROMs and higher density P/ROMs as they are developed. Pro-Log Corp, 2411 Garden Rd, Monterey, CA 93940, has equipped the module with high/low voltage verification and parametric testing. . . . **Diskette Stores Microcomputer's BASIC Interpreter Object Program**—A mini-floppy based BASIC interpreter has been developed by Microsoft for the SYSTEM 65 microcomputer development system from Rockwell International's Electronic Devices Div, 3310 Miraloma Ave, PO Box 3669, Anaheim, CA 92803. It is an extension of the ROM-stored BASIC interpreter for the AIM 65 microcomputer. . . .**Microcomputer Thinks With Use of Artificial Intelligence**—Eliza represents an exercise in artificial intelligence simulation that allows a computer to analyze conversational English, respond to questions, and converse with the user at the keyboard. Announced by Radio Shack, a div of Tandy Corp, 1300 One Tandy Center, Forth Worth, TX 76102, for Level I or II Model I TRS-80 microcomputers with 16k of RAM, the program cassette also includes Talking Eliza which speaks through a voice synthesizer.

Three Packaged Systems House Computers And Winchester Discs—Users may choose systems with a NOVA 4/C or microNOVS computer coupled with either a 12.5M- or 25M-byte Winchester nonremovable disc with integral 1.26M-byte diskette.

Who debugged debugging?

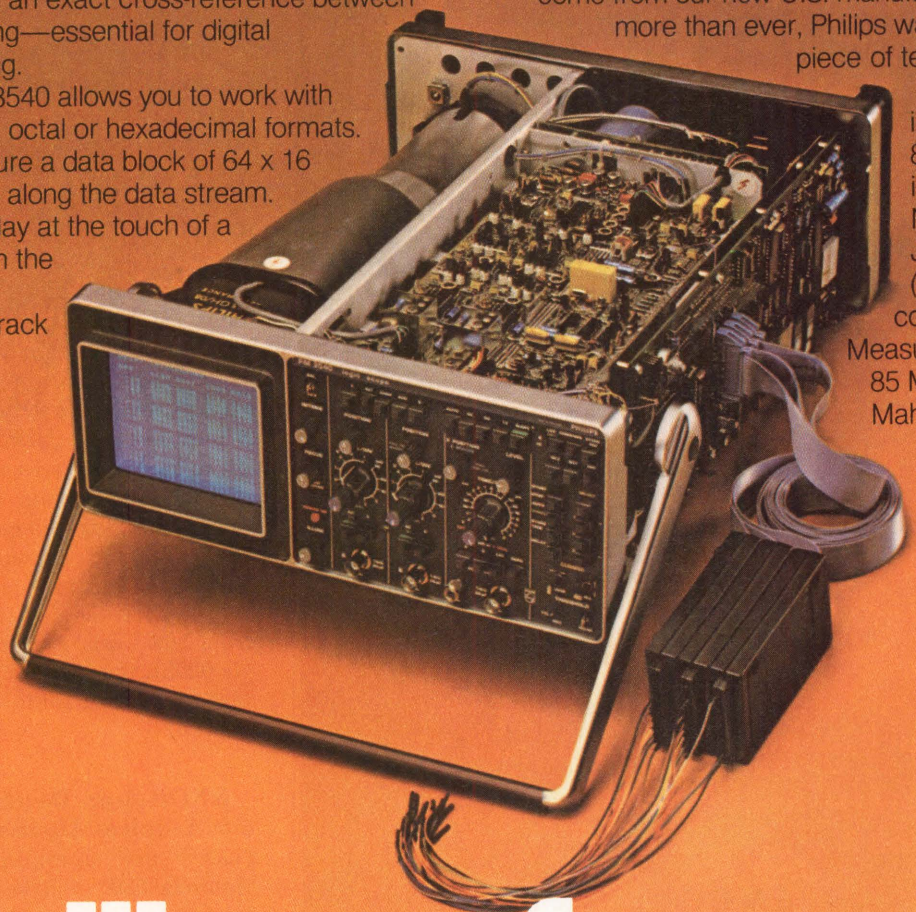
Introducing one of The Glitch Grabbers™ from Philips: the PM3540, a new logic analyzer that's specifically designed for digital debugging. It gets the bugs out fast because the PM3540 is the only compact instrument in the field today that allows data to be displayed, analyzed and then be directly related to real-time situations.

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The PM3540 allows you to work with data in binary, octal or hexadecimal formats. You can capture a data block of 64 x 16 bits anywhere along the data stream. Page the display at the touch of a button through the data stream. Analyze and track down the fault and then set the PM3540 to trigger internally as an oscilloscope.

With the PM3540 you get both logic and real-time analysis in a single, compact, high-performance instrument. An instrument that speeds up your job of locating the bugs and correcting the digital faults.

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Box 4042, Albany, GA 31706, (912) 436-4927
7303 Poplar Lane, Middletown, MD 21769, (301) 371-5588
5456 Blossom Acres Dr., San Jose, CA 95124 (408) 356-0221

MICRO DATA STACK
COMPUTERS, ELEMENTS, AND SYSTEMS

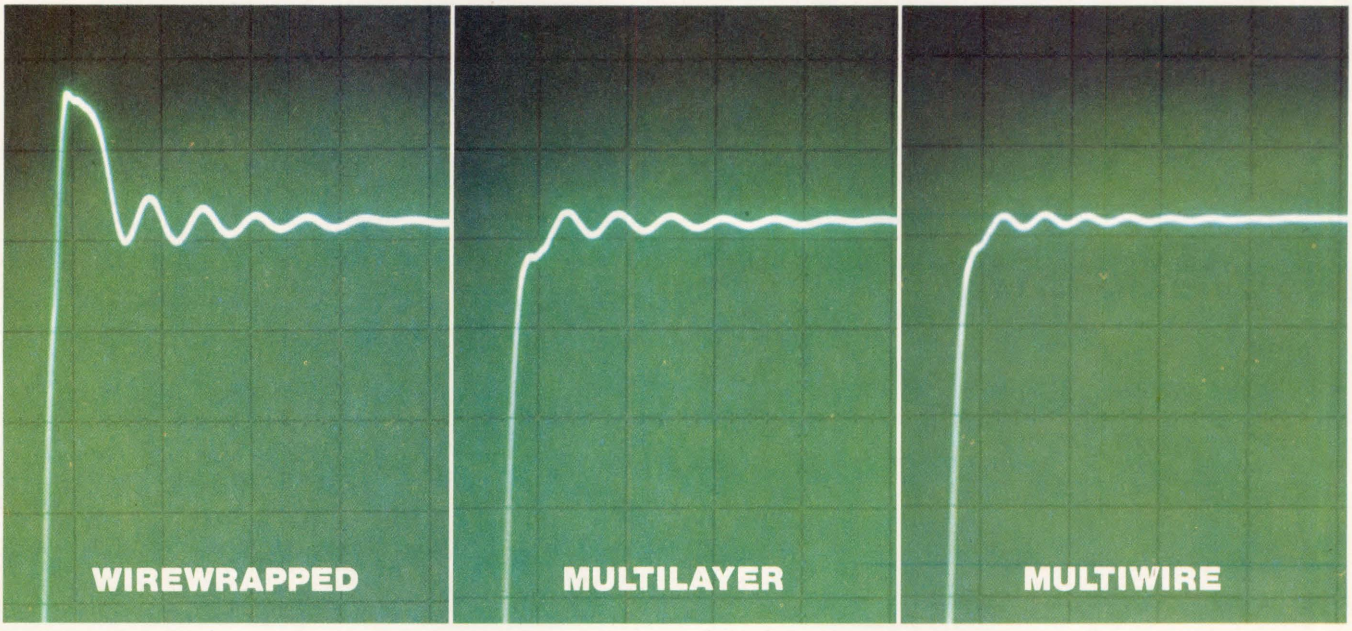
Data General, Route 9, Westboro, MA 01581, also offers packages based on 10M-byte cartridge discs or dual 315k-byte/drive diskettes. . . .**Video Terminal Contains Complete Computer**—An LSI-11/23 CPU and from 64k to 256k bytes of memory reside in a DEC VT100 video terminal with a detached keyboard. Either a 4-line serial I/O or multifunction card is available. Chrislin Industries, Inc, Computer Products Div, 31352 Via Colinas-#102, Westlake Village, CA 91361, offers the DEC RX02 1M-byte floppy disc system or a 10M-byte cartridge disc system as optional.

Software Tool Sorts and Merges Business Information—DSM is a machine language, random file system that sorts large multiple diskette files on a minimum 1-drive Mod-II or 2-drive Mod-I TRS-80 system. RACET COMPUTES, 702 Palmdale, Orange, CA 92665, offers the system for large mailing list and inventory control applications. All records are physically rearranged without key files. . . .**Microhybrid 2-Quadrant Dividers Instantly Produce Quotient of Two Variables**—Interfacing with microprocessor based systems, models 503 through 506 contain a transconductance dividing element, a stable reference, and an output amplifier. They divide in two quadrants with a transfer function of 10X/Y. Available from SGR Corp, PO Box 391, Canton, MA 02021, they feature dividing errors that range from 1.0 to 0.1%.

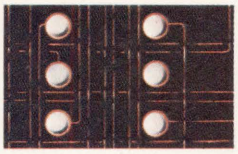
EXORciser Development System Acquires Alternate DOS—The FLEX™ disc operating system for Motorola 6800 EXORciser systems using EXORdisk II or III provides dynamic file space allocation, file accessing, batch job type program entry, and automatic drive searching. The user bootstraps the operating system from a disc instead of MDOS. Support software from Technical Systems Consultants, Inc, PO Box 2570, West Lafayette, IN 47906, includes an editor, assembler, debug package, and text processor. □

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CIRCLE 117 ON INQUIRY CARD

WHEN IT COMES TO PUTTING IT ALL ON DISPLAY, THE ORION-60/S4 STANDS ALONE.



Magnavox combines the superior display and control features of the plasma-panel-based Orion-60 terminals with the powerful S4 Micro-Computer System.

The result is a stand alone graphics system that allows you the freedom to develop a wide variety of graphics application and development programs—while maintaining complete control over program storage, program-generated data, library routines and other facilities.

The Orion-60 display terminal offers full graphics with floppy-disc storage, as well as optional rear-projection functions. It lets you create your own displays and enter data by simply touching the screen with your finger. So you can program your own character sets and generate vectors of any length to absolute coordinates. And because the Orion-60 is plasma-based, you'll get bright, high-contrast images free of jitter or distortion.

The S4 Micro-Computer has system software with development capabilities that are as good or better than those found in many larger computer systems.

Features include CP/M* 8080 system utilities, Fortran with 32K RAM, and a full range of graphic utility routines including window, zoom, sub-image movement and rotation.

The Orion-60/S4.

For a demonstration, call or write Tyler Hunt at Magnavox Display Systems, 2131 South Coliseum Boulevard, Fort Wayne, Indiana 46803, (219) 482-4411.

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DISPLAY SYSTEMS

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CIRCLE 118 ON INQUIRY CARD

SOFTWARE

Programs developed under these systems must be offloaded to the target processor for test. Facilities implement the offloading mechanism as a direct transfer from memory via a byte stream over a CPU port or via .COM or .HEX disc files.

Allen Ashley, 395 Sierra Madre Villa, Pasadena, CA 91107, offers the software on CP/M 8" (20-cm) soft-sector (3741), 5" (13-cm) North Star, or 5" (13-cm) Micropolis Mod II diskettes for $150. The three systems are the SYSTEM-48 for Intel's 8048, the -18 for RCA's 1802/1804, and the -CP4 for National Semiconductor's COP-400 series.

Circle 473 on Inquiry Card

CP/M Cross Assemblers Share Common Editor/ Assembler Structure

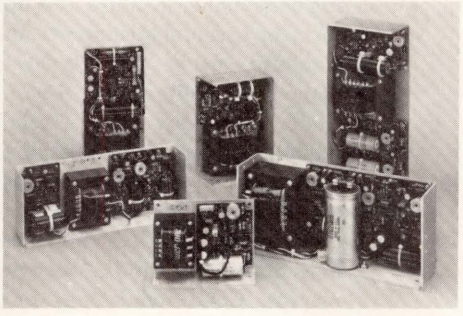
Development software enables any CP/M system to serve as a development station for the Intel 8048 series, RCA COSMAC 1802, and National Semiconductor COP-400 series of single-chip microprocessors. These systems include a macro assembler, an interactive editor/assembler, and a text editor. The memory to memory assembler enables fast program creation and modification. Source programs may be saved on disc.

The common editor/assembler structure features uniform procedures for program entry, modification, assembly, and disc file handling and storage of assembly language programs for the target processor. With minor exceptions, the assemblers have instruction mnemonics and syntax as defined by the microporcessor manufacturers. The macro assembler includes full macro and conditional assembly features as well as the ability to chain a series of source files together during a single assembly. The line oriented text editor creates and modifies source programs within the memory file area. Featuring conditional assembly, the 2-pass assembler translates source to object code. It operates the currently active source file only. Up to six source files simultaneously reside in memory.

The system executive handles all I/O operations, invoking the editor or assembler, and deals with the disposition of source and object files in central memory. Assembly language source programs are maintained in source files under control of the system executive. Source files are created and deleted by commands to the executive. Source code is entered into the source files under control of the editor, and the assembler can be directed to translate the source file to object code anywhere in memory.

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+ 5V @ 9A	– 5V or – 12V @ .8A	+ 24V @ .7A/4.5A PK	CP384	$120.00

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+ 5V @ 2A	+ 12V @ 4A	CP323	$ 74.95

CP323 powers up to (4) drives simultaneously.

FLOPPY DISK - 8" MEDIA

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1st Output	2nd Output	3rd Output	Model	Price (1-9)
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+ 5V @ 2.5A	– 5V @ .5A	+ 24V @ 3A/3.4A PK	CP206	$ 91.95
+ 5V @ 3A	– 5V @ .6A	+ 24V @ 5A/6A PK	CP162	$120.00
+ 5V @ 1.7A/2.2A PK	– 5V @ .15A/.2A PK	+ 24V @ .2A/3A PK	CP272A	$ 91.95
+ 5V @ 2A	+ 12V @ .4A	– 12V @ .4A	HTAA-16W	$ 49.95

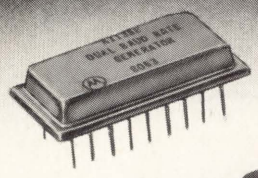
CP272A powers Persci Drives (includes unregulated 7 - 10V @ 1.2A/10A PK). HTAA-16W powers Persci controller.

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CIRCLE 119 ON INQUIRY CARD

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K1135A, B
BAUD RATE
GENERATORS



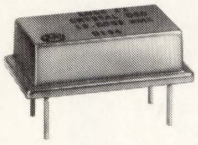
K1152A
CMOS/NMOS
COMPATIBLE



K1160A
MOS
Z8000, Z80A
DRIVER



K1150A
CMOS
8041/8741
DRIVER

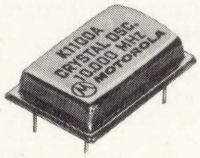


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CIRCLE 120 ON INQUIRY CARD

MICRO DATA STACK
COMPUTERS, ELEMENTS, AND SYSTEMS

Software Assembles 8086 Code At A Rate Of Over 1000 Lines/Min

XMACRO-86 assembles 8086 code on any 8080 or Z80 development system that runs CP/M, ISIS-II, or TEKDOS. The modified version of MACRO-80 contains the same major features of relocation, macros, conditional assembly, and listing and loader control; it does not assemble 8080 or Z80 instructions. It offers a 1000-line/min assembly rate.

Designed for efficiency in assembling code and ease of use, this nontyped form of assembler supports the Intel standard macro facility. Nesting of macros is limited only by memory. Code is assembled in relocatable modules that are manipulated with the flexible linking loader. An expanded set of conditional pseudo operations includes testing of assembly pass, symbol definition, and parameters to macros. Conditionals may be nested up to 255 levels.

Other features of the assembler from Microsoft, 10800 NE 8th, Suite 819, Bellevue, WA 98004, are comment blocks, variable input radix from base 2 to base 16, titles and subtitles, variable page size, octal or hexadecimal listings, and a set of listing controls. Statements are included for printing assembly or diagnostic messages, and to allow code to reside in one area of memory but execute in another.

With the LINK-80 linking loader, any number of programs may be loaded with one command, relocatable modules may be loaded in user specified locations, and external references between modules are automatically resolved. The loader performs library searches for system subroutines and generates a load map of memory that shows locations of main program and subroutines. A cross reference facility CREF-80 prints out an alphabetic listing of all program variable names along with line numbers and where they are referenced and defined.

Circle 474 on Inquiry Card

Software Package Adds Extensions To FORTRAN IV Language

A FORTRAN IV software package, FORT/LIFT, consists of 24 FORTRAN IV callable subroutines. Character string and substring processing functions offer character string handling and manipulation capability. Tables of symbolic information can be created and updated using ordered table manipulation functions.

Disc files are sorted based on up to five sort keys, either variable length character or numeric. The self-contained keyed file access method creates and maintains files that are randomly accessed by free-format record keys. An in-memory sort of integer or floating point arrays is also included. Software'70, Box 3623, Anaheim, CA 92803, supplies the package in source deck form, magnetic tape, or paper tape at a 1-time lease of $295.

Circle 475 on Inquiry Card

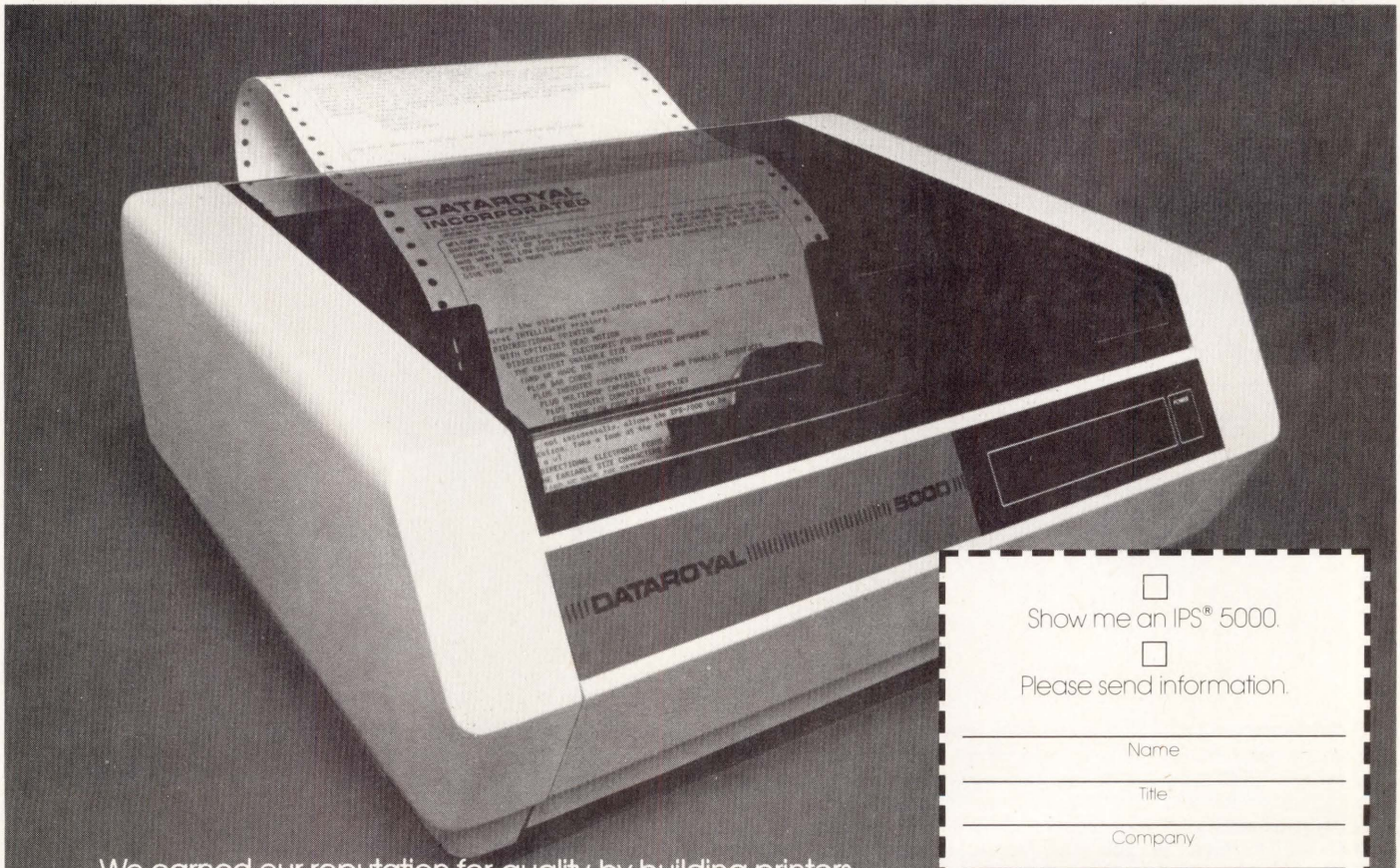
Software Package Allows Cross Development Of Microcomputer Code

Users of PDP-11 systems can employ the Z8000 cross-software package to take advantage of larger computer system tools to develop software for their Z8000 based products. The package runs on the DEC PDP-11/45 and PDP-11/70 systems using Western Electric's UNIX timesharing operating system.

A compiler for the C programming language, code optimizer for the C compiler, Z8000 assembler, linker, and upload/download program that is compatible with Zilog's Z8000 development module are components of the package. As an ideal software development environment for the Z8000, the tools generate efficient code for the 16-bit microprocessor. This is because Zilog Inc, 10460 Bubb Rd, Cupertino, CA 95014, was influenced by the architecture of the PDP-11 when designing the Z8000. The package costs $10,000.

Circle 476 on Inquiry Card

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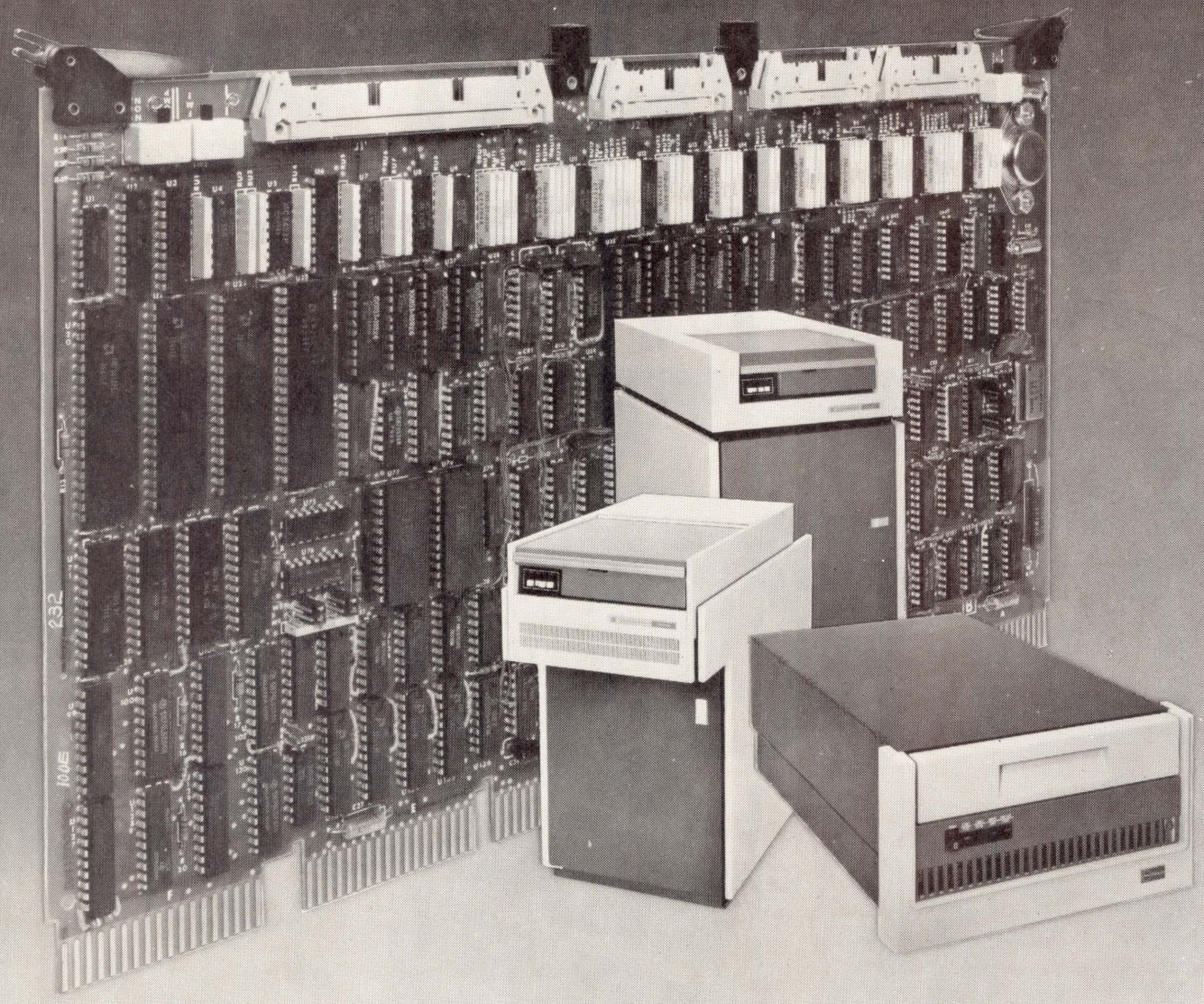
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Dayton, Ohio 45419
(513) 294-6426

160 Centennial Way
Tustin, California 92680
(714) 838-4530

CD 58

CIRCLE 122 ON INQUIRY CARD

NEW SMD CONTROLLER for
Plessey's family of disc subsystems for the PDP-11*



PLESSEY'S PM-DC1100 disc controller provides a reliable interface between your PDP-11 and a wide range of drives with industry standard, SMD-type interfaces, including the latest Winchester minimodule devices. The low-cost PM-DC1100 is designed for realistic expansion of your present RP02/RP03* series subsystem data base to more than 538/2000 Mbytes of hard disc storage. For PDP-11 users without an RP series subsystem, the PM-DC1100 is available with selected drives, cables and DEC*-compatible software as a complete subsystem. Model numbers and formatted capacities are:

PM-DSA11/32	27 Mbyte	(1 removable, 1 fixed disc)
PM-FS11/33	25 Mbyte	(1 fixed, Winchester)
PM-DSA11/80	67 Mbyte	(1 disc pack)
PM-DSA11/300	256 Mbyte	(1 disc pack)

The PM-DC1100 controller is completely transparent to your operating systems and diagnostics that support the RP series controllers. It's also pin-to-pin, signal, and power compatible with DEC backplanes. Just plug the SINGLE hex board into your PDP-11 computer, and cable directly to one or two drives. With a multidrive interface chassis and minor software patches, the controller can support up to eight drives.

The microprocessor based controller features a high transfer rate of 1.2us/word, transparent ECC, multiword DMA transfer, and many other benefits you expect from the leading producer of DEC-compatible peripherals.

Plessey's reputation for quality, service, delivery, reasonable prices, and worldwide support, has made us the largest independent supplier of DEC-compatible equipment. Our product line includes add-in/add-on, core, and semiconductor memories; cartridge, disc pack, floppy, mag tape controllers and subsystems; mini/microcomputer systems; DEC-compatible software; and a wide variety of backplanes, expansion chassis and other accessories. All Plessey products include applicable hardware and software documentation, plus warranty with maintenance/installation options.

Contact your nearest regional sales office for more information on the PM-DC1100 controller, subsystems, or any Plessey product.

Plessey Peripheral Systems

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Irvine, CA 92714
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CIRCLE 123 ON INQUIRY CARD

MICRO DATA STACK
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MAGNETIC BUBBLE MEMORY UPDATE

Michael Chester
West Coast Editor

In 1979 and early 1980, a number of developments advanced the status of magnetic bubble memories and considerably increased the options available to the user. Previously, the marketing of bubble memory chips and boards was the exclusive domain of Texas Instruments and Rockwell International. While those two companies remain active in this field, they now face competition from Intel Magnetics, Fujitsu, National Semiconductor, and Hitachi.

One of the major advancements in the period has been the development of bubble memory chips to the 1M-bit level. The first megabit device announced was the 7110 from Intel Magnetics, followed a few months later by the TIB1000 from Texas Instruments. Announcement of a 1M-bit device, the RBM411 from Rockwell, is expected at any time.

A Pin-Compatible Megabit Family

In the fall of 1979, Texas Instruments Inc announced a family of magnetic bubble memory chips, headed by a 1M-bit device. Although this was not the first 1M-bit bubble memory to be introduced (Intel Magnetics having announced a few months earlier), it was the first effort by a company to market a pin-compatible series of bubble chips having a range of capacities. The 1M-bit chip was the TIB1000, a dual structure, having a block-replicate/swap architecture and containing 300 minor loops on each of its identical halves. Subtraction of loops defined as redundant and those allocated to error correction coding leaves a total of 256 data loops on each half, with each loop able to store 2049 bits. Refinements in photolithography have led to the implementation of the full 1M-bit capacity on a chip whose area is 149,000 sq-mils, less than 1 cm^2.

A 0.5M-bit capacity results when a single block of 300 minor loops is utilized, as in the TIB0500, which has half the area of the 1M-bit chip. The third member of this family (all of which are provided in 24-pin DIPs) will be designated as TIB0250, and is scheduled for announcement in the fourth quarter of 1980. It will have a 0.25M-bit capacity and will be implemented as a scaled down version of the 0.5M-bit architecture, providing 256 data loops and a 5.6-ms access time, on a chip approximately one-third the area of the 1M-bit chip.

The design of this quarter-megabit memory provides an interesting contrast to Texas Instruments' earlier 0.25M-bit device, the TIB0303. That memory offered a 7.3-ms average access time and was implemented on a chip having approximately three times the area of its successor. This discontinued bubble memory also used a block-replicate/swap architecture. Before being withdrawn, it was marketed in sample quantities only. Its termination resulted from its being overshadowed by the forthcoming chip family. Peripheral circuits that were being designed to support the original chip were undergoing modification to fit the later series. Furthermore, the much lower density, longer access time, and nonbinary organization (224 data loops providing 254k bits) made it less satisfactory than the later products from this manufacturer.

At the time of this writing, the later chips (in both 1M- and 0.5M-bit versions) are being marketed in sample quantities, on a board rather than a chip basis. Evaluation boards are the TBB5010, utilizing a single 1M-bit chip, and the TBB5005, utilizing a single 0.5M-bit chip. These designs are virtually identical, including LSI support chips functioning



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Bubble Memory Parameters

Company,[a] Part No, Introduction	Capacity, Architecture, Packaging	Minor Loops Bits/Loop	Access Time,[b] Field Rate, Data Rate	Temperature Range Operating	Temperature Range Nonvolatile Storage
Texas Instruments TIB0203 1977	92k Bit Major-Minor 14-Pin DIP	157 Loops 144 Data 13 Redundant 641 Bits/Loop	4.0 ms 100 kHz[d] 46k Bits/s	0 to 50 °C	– 40 to 85 °C
Texas Instruments TIB0303 1978	254k Bit Block Replicate (Swap) 20-Pin DIP	252 Loops 224 Data 28 Redundant 1137 Bits/Loop	7.3 ms 100 kHz 89k Bits/s	0 to 50 °C	– 40 to 85 °C
Rockwell Internat'l RBM256 1978	256k Bit Block Replicate 18-Pin DIP	282 Loops 256 Data 22 Redundant 4 Housekeeping 1025 Bits/Loop	<4 ms 100 or 150 kHz 91k or 136k Bits/s	0 to 70 °C[f]	– 40 to 100 °C
Fujitsu FBM31DB 1978	74k Bit Serial Loop 18-Pin DIP		370 ms 100 kHz 100k Bits/s	0 to 55 °C	– 40 to 85 °C
Fujitsu FBM32DA 1978	81k Bit Major-Minor 18-PIN DIP	142 Loops 138 Data 4 Redundant 587 Bits/Loop	4.5 ms 100 kHz 97k Bits/s	0 to 55 °C	– 40 to 85 °C
Intel Magnetics 7110/7112 1979	1M Bit Block Replicate (Swap) 20-Pin Leadless	320 Loops 256 Data 16 ECC 48 Redundant 4096 Bits/Loop	40[e]/20 ms 50[e]/100 kHz 68[e]/136k Bits/s[g]	Options vary from 10 to 35 °C to 0 to 70 °C	– 40 to 100 °C
Fujitsu FBM42DA 1979	283k Bit Major-Minor 16-Pin DIP	268 Loops 258 Data 10 Redundant 1097 Bits/Loop	8.5 ms 100 kHz 96k Bits/s	0 to 55 °C	– 40 to 85 °C
Fujitsu FBM43DA 1979	273k Bit Block Replicate 20-Pin DIP	273 Loops 265 Data 8 Redundant 1033 Bits/Loop	6 ms 100 kHz 97k Bits/s	0 to 55 °C	– 40 to 85 °C
Texas Instruments TIB1000 1979	1M Bit Block Replicate (Swap) 24-Pin DIP	2 Blocks Each Organized As: 300 Loops 256 Data 18 ECC 26 Redundant 2049 Bits/Loop	11.2 ms 100 kHz[e] 171k Bits/s	0 to 50 °C	– 40 to 85 °C
Texas Instruments TIB0500 1979	0.5M Bit Block Replicate (Swap) 24-Pin DIP	300 Loops 256 Data 18 ECC 26 Redundant 2049 Bits/Loop	11.2 ms 100 kHz 85k Bits/s	0 to 50 °C	– 40 to 85 °C
National Semi NBM2256 1980	256k Bit Block Replicate (Swap) 16-Pin DIP	282 Loops 256 Data 6 ECC 20 Redundant 1024 Bits/Loop	7 ms 100 kHz 91k Bits/s	0 to 70 °C[f]	– 40 to 100 °C
Rockwell Internat'l RBM411 2nd Quarter 1980?	1M Bit Block Replicate 18-Pin DIP	572 Loops 512 Data 11 ECC 4 Housekeeping 45 Redundant 2052 Bits/Loop	8 ms 100 or 150 kHz 90k or 135k Bits/s	0 to 70 °C[f]	– 40 to 100 °C
Texas Instruments TIB0250 4th Quarter 1980?	256k Bit Block Replicate (Swap) 24-Pin DIP	300 Loops 256 Data 18 ECC 26 Redundant 1025 Bits/Loop	5.6 ms 100 kHz 85k Bits/s	0 to 50 °C	– 40 to 85 °C

[a]Devices are listed in order of initial availability dates. This sequence is only approximate, since announcements, initial sampling, and production shipping dates are not consistently sequenced by various manufacturers, and an exact date is not always easily defined

[b]Minor loop geometry results in output streams whose consecutive bits are separated by two field positions. In one case output bit rate is half of rotating field frequency. But most devices attain bit rates equal to field rate through merging two separate data streams from odd and even sets of minor loops. Some architectures lead to a bit rate that is twice the field rate. Data rate is obtained in all cases by multiplying bit rate by ratio of number of data loops to total number of minor loops; in some cases it undergoes further reductions due to delays at the controller

[c]Most manufacturers specify allowable temperature range in relation to ambient temperature. However some specify in terms of case temperature. These two types of specifications are not directly comparable

Power Dissipation[c]	Package Area Die Area, Bubble Diameter	Redundancy Mapping Method	Status	Boards and Systems (Partial List)
700 mW	1.1 in² (7 cm²)	P/ROM or	Shipping in	TM990/210 microcomputer module. Peripheral circuits and up to 6 bubble chips on single board
	0.12 in² (0.8 cm²) 5 μm[h]	Onchip Blocks	Production Quantities	
900 mW	1.44 in² (9 cm²) 0.16 in² (1 cm²) 3 μm	Dedicated Loop	Discontinued	
820 mW	1.44 in² (9 cm²) 0.15 in² (1 cm²) 4 μm[i]	P/ROM	Shipping Production Quantities; 2nd Sources Licensed	Two-board system. RCM650 controller module, RLM658 linear memory module using 4 memory chips. Expandable to 16 boards (2M bytes)
500 mW	1.34 in² (8.7 cm²) 0.05 in² (0.3 cm²) 3 μm	Package Label	Shipping in Production Quantities	296k-bit FBC304M1A hosts 4 memory chips. (OEM board)
670 mW	1.34 in² (8.7 cm²) 0.05 in² (0.3 cm²) 3 μm	Package Label	Shipping in Production Quantities	324k-bit FBC304D2A hosts 4 memory chips. (OEM board)
1.9 W (290 mW Standby)	2.86 in² (18 cm²) 0.3 in² (2 cm²) 2.7 μm	Dedicated Loop	Shipping 7110 in Production Quantities; 7112 Scheduled for 4th Quarter 1980	Single-board systems with control circuitry: IMB100 Development Board, iSBC250 OEM board up to 1M Byte
670 mW	1.34 in² (8.7 cm²) 0.15 in² (1 cm²) 3 μm	Package Label	Sampling	
670 mW	1.34 in² (8.7 cm²) 0.15 in² (1 cm²) 3 μm	Package Label	Sampling	
1.2 W	1.82 in² (12 cm²) 0.15 in² (1 cm²) 2 μm	Dedicated Loop	Sampling	Evaluation board TBB5010—single 24-in² board with peripherals and 1 bubble chip. TM990/211—up to 6 memory chips
1.2 W	1.82 in² (12 cm²) 0.075 in² (0.483 cm²) 2 μm	Dedicated Loop	Sampling	Evaluation board TBB5005—single 24-in² board with peripherals and 1 bubble chip
750 mW	1.2 in² (8 cm²) 0.1 in² (0.6 cm²) 2.7 μm	Dedicated Loop	Sampling	NBS100 Evaluation board—1 bubble chip and control circuitry; NBS101 expansion board—4 bubble chips, expandable to 8 chips. OEM board, 9 in², will hold 1 bubble die and 5 IC peripherals
1.4 W	1.44 in² (9 cm²) 0.15 in² (1 cm²) 2 μm	P/ROM or Onchip Blocks	Sampling, 2nd Sources Licensed	Single-board system will host 1 or 2 memory chips and provide control circuitry. Will also accept RBM256
1.2 W	1.82 in² (12 cm²) 0.04 in² (0.3 cm²) 2 μm	Dedicated Loop	Not Yet Available	

[d]Output bit rate equal to one-half of the rotating field frequency

[e]Output bit rate equal to twice the field rate

[f]Temperature range specified in terms of case temperature

[g]In this case data rate undergoes further reductions due to delays at the controller

[h]More recent S version has 3-μm bubbles on 0.37-cm² chip

[i]Version with 2-μm bubble diameter will be announced at about same time as 1M-bit chip

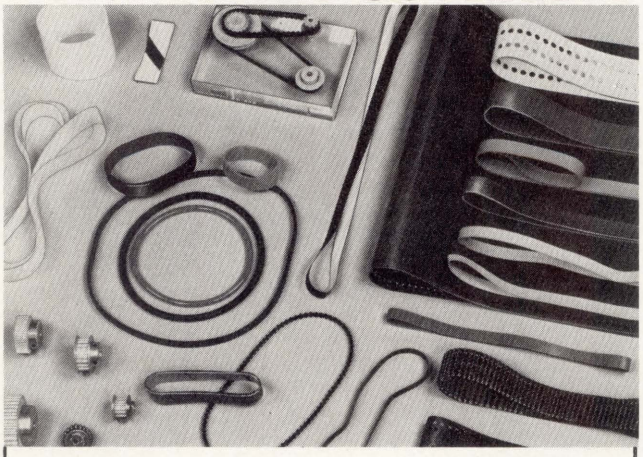
as a controller, sense amplifier, coil driver, function timing generator, and function drivers. Board area is 4 x 6" (10.2 x 15.3 cm).

Production and Second-Sourcing

Another 0.25M-bit bubble memory chip, the RBM256 from Rockwell International's Electronic Devices Div, has been available in production quantities since the third quarter of 1979, including the stocking of local distributors, nationwide. The only 0.25M-bit bubble memory to be in full production at this time, the device was originally introduced in October 1978. This manufacturer is also the only one so far to provide second-source outlets; both Motorola Semiconductor and Siemens are licensed by Rockwell to produce the 0.25M-bit chip.

Although this memory has a block replicate architecture, it does not use swap gates. Instead, transfer gates are used for data input and transfer/replicate gates are used for output. A block of data that is to be saved after being read is replicated onto the read track. However, if a block of data is to be purged to make way for new input data, the transfer function is selected at the output gates and the data are moved to the read track for annihilation. (This destructive read option is needed because there are no swap gates at the inputs and, therefore, no destructive write operation.) The vacated block, containing all zeros, is then cycled back into position under the read gates, where the new data block is transferred in. This design results in an increased write time, although read access time (<4 ms) is not affected.

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The added write delay is not considered serious for several reasons, one being that a memory of this kind is generally used as a read-mostly memory. In addition, the usual organization of related data into consecutive blocks considerably reduces the effects of a write delay. Finally, the penalty is not statistically very significant, even when writing into a random block location.

This architecture does produce certain compensating advantages. By not using swap gates, the designers obtained superior operational tolerances, since design requirements on replicate and transfer gates are not as stringent as those for swap gates, which are essentially dual structures built for 2-way transfers and require higher densities.

Rather than making use of onchip redundancy mapping, this chip is accompanied by a P/ROM where the mapping information is stored. This approach is justified by the manufacturer in terms of reliability, with the map information being preserved in the event of a chip failure. Other manufacturers dispute this approach, citing the manufacturing burden of providing coordinated parallel development of the P/ROM and bubble chips, and also noting that redundancy information can be visibly printed on the surface of the package to provide backup to the onchip map (a tactic used, for example, by Texas Instruments) or can be provided in support documentation.

The memory is available on a board- as well as chip-level basis. Two boards are required, the 1M-bit RBM256 linear memory module, utilizing four of the bubble memory chips, and the bubble memory controller module, RCM650, providing peripheral circuitry.

However, a single-board system is approaching production. This board will host not only the 0.25M-bit chip (or two chips for a 0.5M-bit option), but will also provide single- and double-chip options for the 1M-bit chip, RBM411, from this manufacturer.

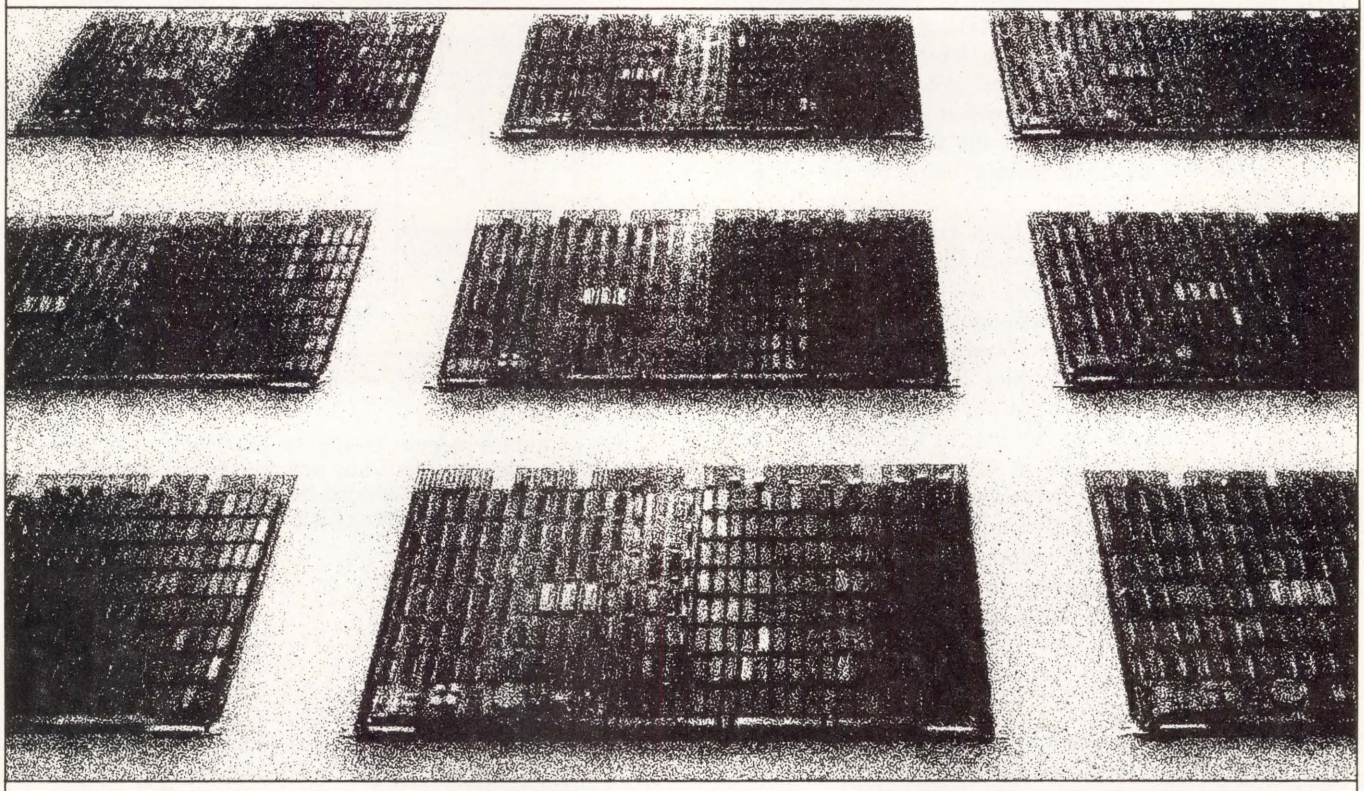
The 1M-bit chip uses the same architecture and operating mode as the 0.25M-bit chip, provides the same temperature capabilities, and will make use of the same second-source vendors. Its read access time is 8 ms. Tradeoffs between onchip redundancy mapping vs mapping on a P/ROM are resolved in this design by providing either option, although the manufacturer continues to recommend the P/ROM approach. For those who prefer an onchip map, four additional blocks are provided (rather than a dedicated loop), a technique designed for simpler addressing and fewer pinouts.*

Pin for pin compatible with the 0.25M-bit chip (both being housed in 18-pin DIPs), the 1M-bit memory is being produced in sample quantities, and orders are being taken. Formal announcement is expected shortly.

In addition to Rockwell's 0.25M-bit device, another commercially available bubble memory chip has seen wide distribution. This is the 92k-bit TIB0203 from Texas Instruments, the first commercial chip to be announced (in September 1977), which continues to be shipped to OEMs in production quantities at the time of this writing. It is based on a major-minor architecture, utilizing 157 minor loops,

*Manufacturers who favor a dedicated bootloop for redundancy mapping cite the risk of accidentally writing data into redundancy blocks.

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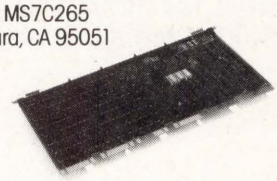
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144 of them usable (the remaining 13 redundant), with 641 bits per loop.**

Intel's 1M-bit memory is also being marketed in production quantities. Some of the OEMs utilizing this product are said to have been in production for more than six months.

Fujitsu America has issued a variety of architectures in a comparatively brief period of time. These have included a 74k-bit single-loop serial chip (FBM31DB) having an average access time of 370 ms, and an 81k-bit major-minor chip (FBM32DA), with average access time of 4.5 ms. Each of these is available in production quantities at a chip or at a board level, with four serial chips on the 296k-bit FBC304M1A board or four of the major-minor chips on the 324k-bit FBC304D2A.

A larger major-minor chip from Fujitsu, the FBM42DA, provides 283k bits via a 268-loop architecture, 258 of these being good, having a capacity of 1097 bits/loop. Most recently, this manufacturer has announced a 273k-bit block replicate device, the FBM43DA. Having a mean access time of 6 ms, this memory resembles Rockwell's in utilizing replicate and transfer gates, but not swap gates. These two memories from Fujitsu, described as being in the "quarter-megabit class," are available in sample quantities.

Announcement of the market availability of a 0.25M-bit block-replicate device from Hitachi America appears, at this time, to have been delayed indefinitely. It is expected that the company will shift, instead, to the release of a 1M-bit device in the late third or early fourth quarter of 1980.

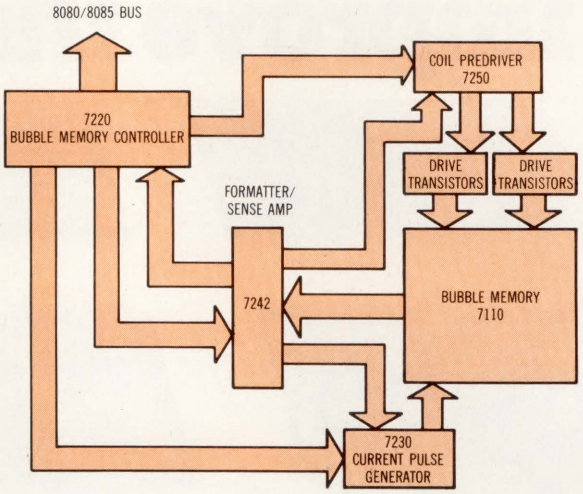


Fig 1 Bubble memory configuration. Using 7110 1M-bit memory chip plus four LSI peripherals and two quad-transistor packs, system can be implemented on board having 16-in² (103-cm²) area (Courtesy of Intel Magnetics)

Peripheral Circuits

Although entering the bubble memory competition later than Texas Instruments or Rockwell, Intel Magnetics became the first manufacturer to announce the availability of a 1M-bit chip, the 7110. A total of 320 minor loops, containing 4096 bits per loop, provides 256 data loops (with 48 redundant and 16 for ECC). The 50-kHz field frequency results in a comparatively slow 40-ms average access time. A later version, the 7112, will raise field frequency to 100 kHz, reducing average access time to 20 ms. Chip area is approximately 2 cm².

**A recent version of this 92k-bit chip (suffix S) utilizes a reduced device geometry, with bubble diameters dropping from 5 to 3 μm. Although there has been no formal announcement, this version is being shipped and will replace the original chip.

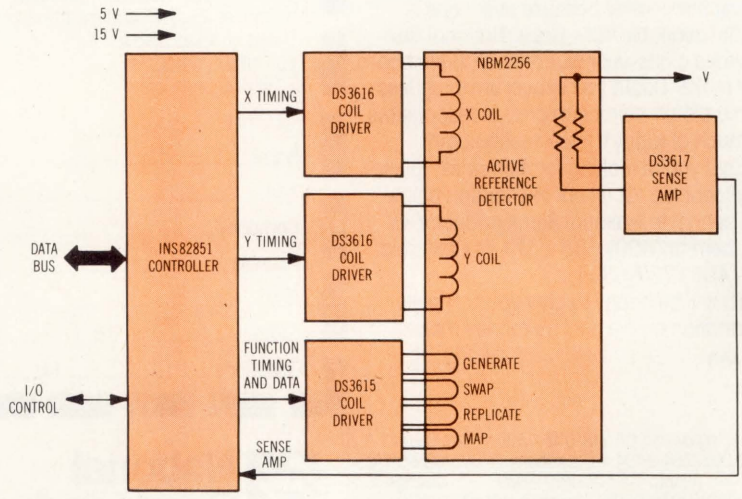


Fig 2 Memory subsystem. Requiring only five ICs in addition to bubble memory chip, system (to be available at later date) will provide 0.25M bits of storage, expandable to 2M bits through use of additional memory chips with same controller (Courtesy of National Semiconductor)

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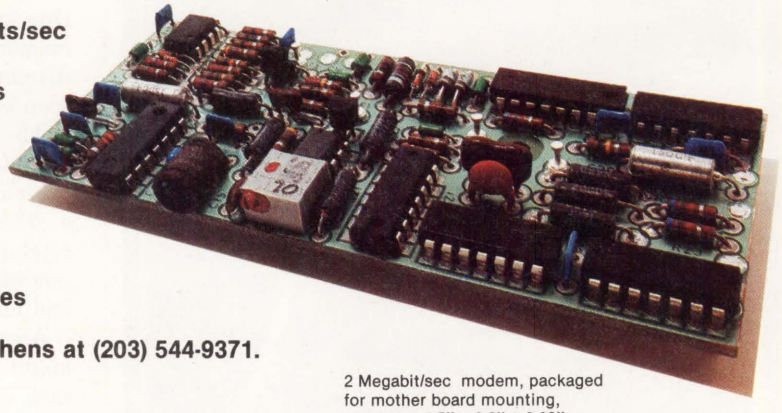
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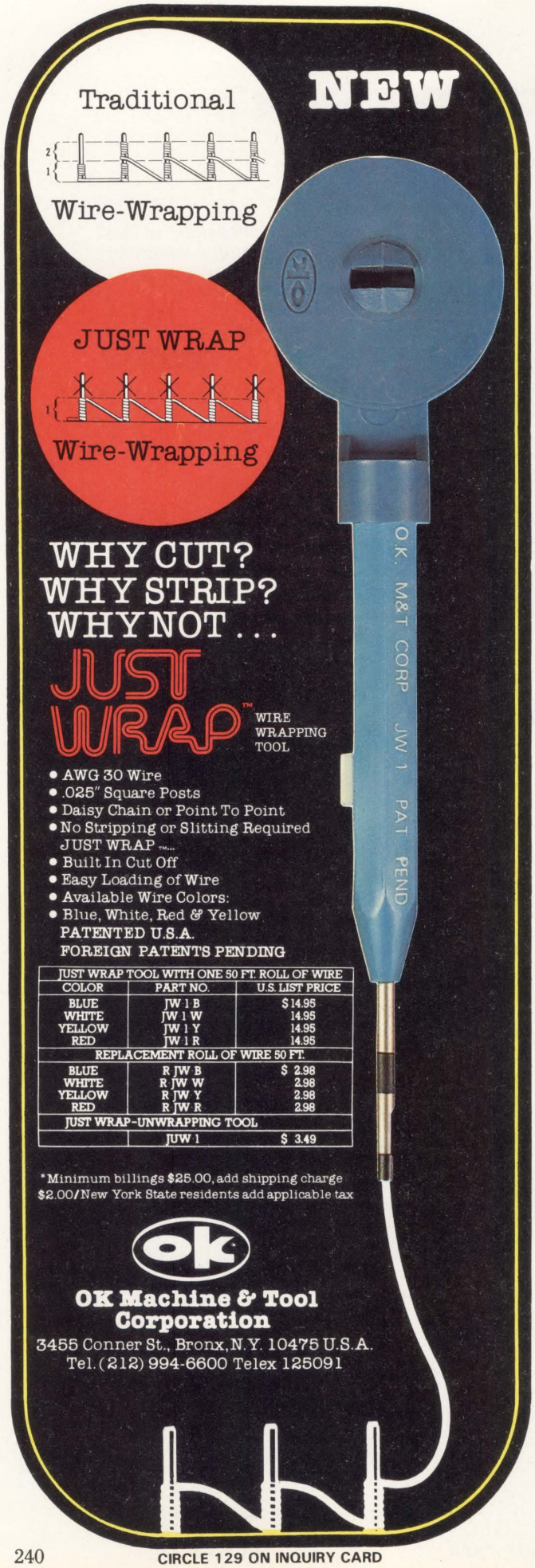


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CIRCLE 128 ON INQUIRY CARD



CIRCLE 129 ON INQUIRY CARD

A principal emphasis in this product has been on the compact support electronics consisting of a total of seven chips, including the memory chip itself (Fig 1). Chips are the 7220 bubble memory controller, 7242 formatter/sense amp, 7250 coil predriver, 7230 current pulse generator, and a pair of 7254 drive transistors. The compact board design contrasts with earlier systems in its small chip count which was accomplished by combining large numbers of functions in single LSI peripherals. For example, the controller used in this design incorporates the timing control capability ordinarily implemented by a separate circuit.

At the system level, a prototype kit (BPK71), a controller emulator kit (CPK72), and a development board (IMB100) are available from Intel. These units are supplied with memory chips and a complete set of peripheral chips to manufacturers in the process of developing systems that are to incorporate bubble memory. An OEM board, the iSBC250, has recently been announced. Incorporating capabilities of the earlier development board as an option, this device includes a single 1M-bit chip, ECC capability, power failure detect, and reset capability. It is expandable to an 8-chip (1M-byte) capacity, utilizing an adjacent board for the additional memory chips without requiring an additional controller. The system is compatible with other devices in the single-board computer line by the same manufacturer.

The latest entry into the field is National Semiconductor with a 256k-bit block-replicate memory, the NBM2256. It contains a total of 282 minor loops: 256 for data, 6 for ECC, and 20 redundant. This memory, now being sampled, provides an average access time of approximately 7 ms to the first bit of a randomly selected data block.

Compact dimensions characterize the chip, whose area is 300 x 320 mils (7.2 x 7.8 mm), based on a 1.5-μm device geometry. The device is packaged in a 16-pin DIP occupying a 1.1 x 1.1" (2.8 x 2.8-cm) board area, having height of 0.36" (0.9 cm) and standard 0.100" (0.254-cm) pin spacing. A memory subsystem (Fig 2) containing this chip along with five ICs (controller, sense amp, function driver, and two coil drivers) will have an area of only 9 in^2 (58 cm^2).

Summary

One specific index of the advances made in the bubble memory field may be seen in the decreasing bubble diameters shown in the Table. A span of three years has seen bubble diameters shrink from 5 to 2 μm.

The technology remains fairly diverse, with a wide range of pinouts, architectural details, and support circuits in evidence. Discussions are being held under the auspices of a JEDEC committee on bubble memory standardization to establish industry standard guidelines, with subcommittees relating to device design, reliability, testability, interfacing, and terminology.

Among various directions that such standardization might follow, some industry sources predict a convergence that emphasizes pin-compatible bubble memory chips. Others foresee that the memory chips themselves will play an essentially transparent role, with standardization occurring at the microprocessor interface of the bubble memory controller. How rapidly ongoing efforts will lead to convergence to industry standards and what direction that convergence will take remain to be seen.



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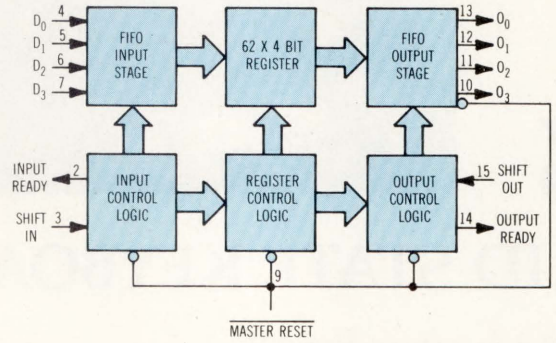
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FIFO Claimed To Be Industry's Fastest and Densest



Expandable fall-through FIFO, 67401A, from Monolithic Memories is organized as 64 x 4. Data rate of 15 MHz allows use of high speed digital signal processing

Organized into 64 4-bit words, and guaranteed for operation at a 15-MHz data rate, the 67401A first in, first out serial memory IC was developed especially for use as a buffer in realtime digital signal processing applications and to satisfy the buffering requirements of digital video processing, fast Fourier transforms, and spectrum analysis. It also finds application in high speed disc controllers. The manufacturer, Monolithic Memories Inc, 1165 E Arques Ave, Sunnyvale, CA 94086, states that it is the fastest and densest FIFO on the market. It is also available in a military version, the 57401A.

This bipolar memory assembles incoming data in a word serial buffer for subsequent readout in the order written, but at a different rate. The device is expandable in both word and bit dimensions. Two or more may be connected in serial to form a memory of 128 words or more, or they can be connected in parallel to form word widths of 8 bits or more.

Other characteristics include TTL inputs and outputs, and operation in synchronous or asynchronous format. Packaged in a 16-pin DIP, with output pins directly opposite corresponding input pins, the part is pin compatible with Fairchild's F3341 MOS FIFO, but is said to be faster by a factor of 15. It also provides 50% more speed than the existing 67401, and is an improved version of that memory.

Some existing users of the earlier model operate the devices in a byte-wide (8-bit) mode and need a means of checking parity. Until now, they have had to use a third device just for the parity function, even through only a portion of the additional FIFO was being used. To simplify parity checking, 5-bit wide FIFOs have been developed: the 67402, guaranteed for operation at a 10-MHz data rate, and the 67402A, guaranteed for 15 MHz. These correspond, respectively, to the original and improved 4-bit devices, and are organized into 64 5-bit words. Both wider-word models are provided in 18-pin packages. All three of the newly announced memories are offered in both standard commercial (5 V ±5%, 0 to 70 °C) and military (5 V ±10%, −55 to 125 °C) versions. The commercial versions are immediately available off the shelf.

Absolute maximum ratings require that supply voltage (V_{CC}) and input voltage remain at 7 V or lower, and that off-state output voltage does not exceed 5.5 V. Storage temperature must stay between −65 and 150 °C.

Circle 504 on Inquiry Card

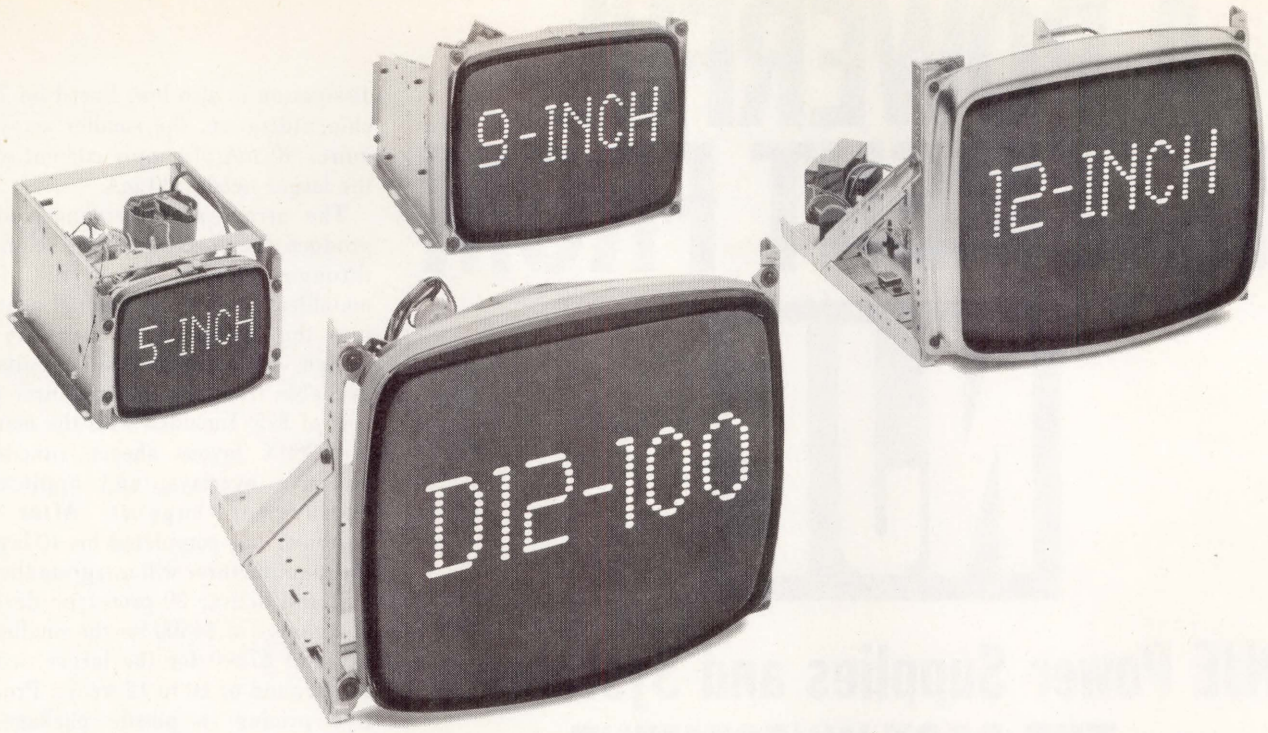
Current Mode Logic Gate Arrays Operate Below 1 pJ

Two current mode logic (CML) gate arrays from Interdesign Inc, 1255 Reamwood Ave, Sunnyvale, CA 94086, provide toggle rates of 20 MHz, propagation delays of 8 ns, and a speed-power product of <1 pJ. The smaller of these arrays, designated MSA, includes 225 array cells, each containing a pair of 2-input gates. It also includes 39 peripheral cells and 40 bonding pads, and has chip dimensions of 157 x 157 mils. The larger array, MSB, has 440 array cells, 48 peripheral cells, 52 bonding pads, and is implemented on a chip measuring 200 x 186 mils.

CML is a logic form similar to ECL. Each CML array cell consists of two pairs of common collector NPN transistors, a current source with two active emitters, plus the necessary load resistors and crossunders. This architecture permits the implementation of two 2-input NOR gates using a single array cell. A 3-input NOR gate and a 2-input NAND gate also use a single cell while a D flipflop can be integrated using only three array cells.

Their fast toggle rate and low power consumption make these arrays useful to designers of the digital systems, especially in the fields of computers, telecommunications, measurement systems, scientific instrumentation, and military or aerospace systems. Some specific applications include disc and CRT controllers, keyboard scanners, ALU accumulators, high speed modems, signal processors, and interface logic.

Other features include a temperature-compensated onchip voltage regulator (approximately 1 V), compatibility with TTL, LS/TTL, and CMOS (5 and 12 V) logic forms, and sufficient output power to drive LED displays. Propagation delays through critical gates can be reduced further to 3 ns by employing multiple current sources and load resistors. Both chips have an operating power supply range of 2.5 to 5.5 Vdc and are rated over the mil spec storage and operating temperature ranges. Because of the low onchip voltage (about 1 V), power



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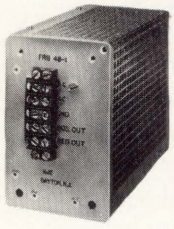
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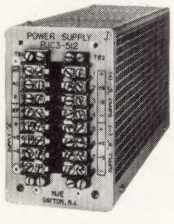
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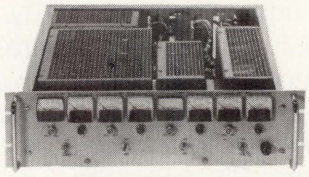
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dissipation is also low. Based on 70% chip utilization, the smaller array requires 90 mA of supply current while the larger needs 130 mA.

The arrays are interconnected to produce the specific circuit required, through etching back the final metallization layer. A manual containing the information necessary to design CML integrated circuits is available from the manufacturer at a cost of $25. Included with the manual are 200X layout sheets, functional adhesive overlays, and application engineering support. After the customer has completed his IC layout, the manufacturer will integrate the circuit and deliver 20 prototype devices, at a charge of $4500 for the smaller array and $7800 for the larger, with a turnaround of 10 to 12 weeks. Production pricing in plastic packages is estimated at $16.25 and $25.00 for the smaller and larger arrays, respectively, in quantities of 1000 pieces. Delivery is 10 weeks after prototype approval.

Circle 505 on Inquiry Card

Electrically Alterable Nonvolatile NMOS Memory Offers 1-Year Storage

Particularly suited for use as a peripheral with 4-bit microcomputers, a 256-bit, electrically alterable NMOS memory has been announced by the Panasonic Co, Electronic Components Div, 1 Panasonic Way, Secaucus, NJ 07094. The MN1208, a fully decoded nonvolatile memory, provides data retention without power supply for one year.

Individual input and output ports offer added design flexibility. Mode, address, and data inputs are obtained through four common input terminals and are latched. In addition to the main 16-word by 16-bit memory, the EAROM provides a separate 1-word, 12-bit memory that is accessed in the same way as main memory.

Other characteristics include 3-state outputs, a 4-bit output data format, and a capability of 10^5 read/write cycles (typ). The device requires two supply voltages, −10 and −33 Vdc. Units are provided in 18-pin plastic dual-inline packages.

Circle 506 on Inquiry Card

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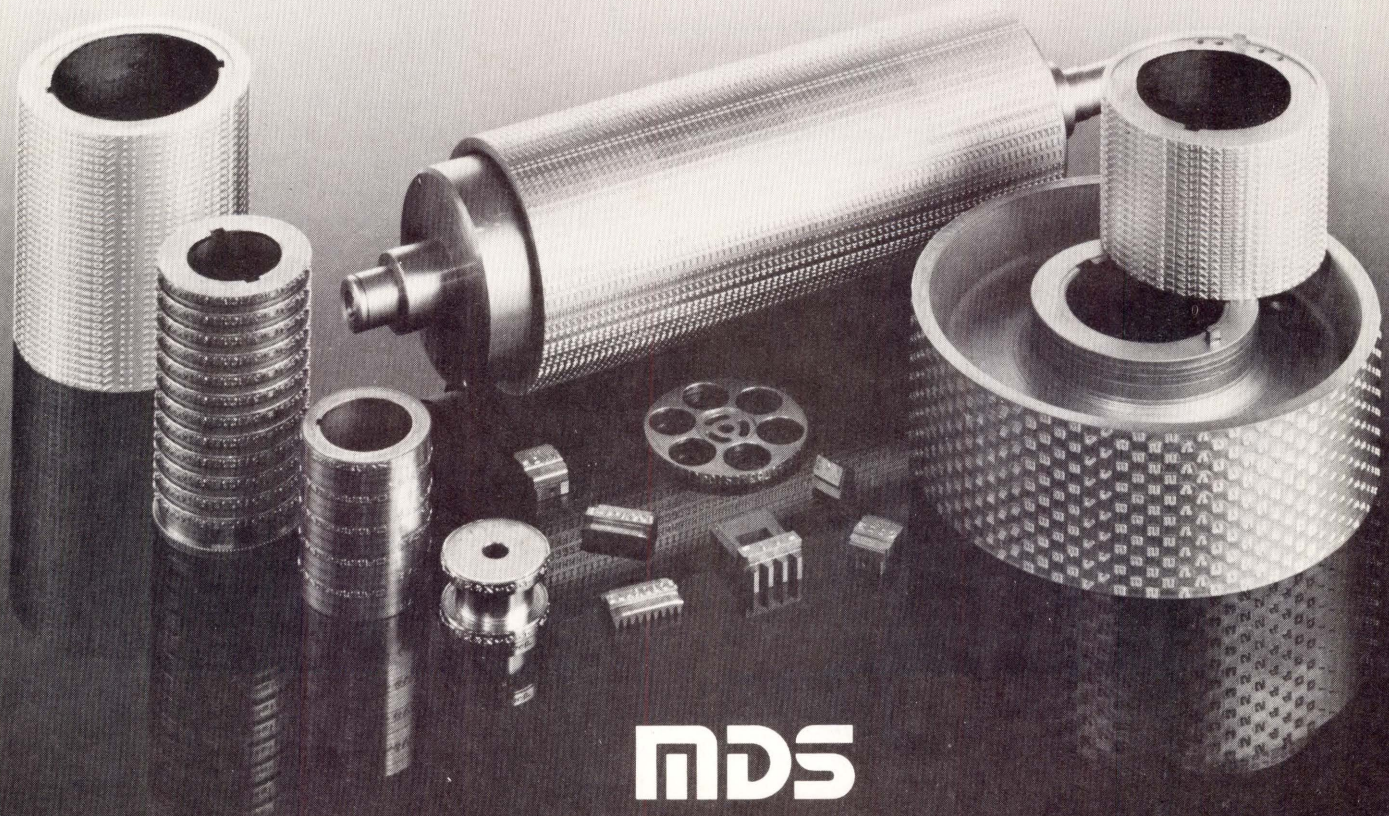
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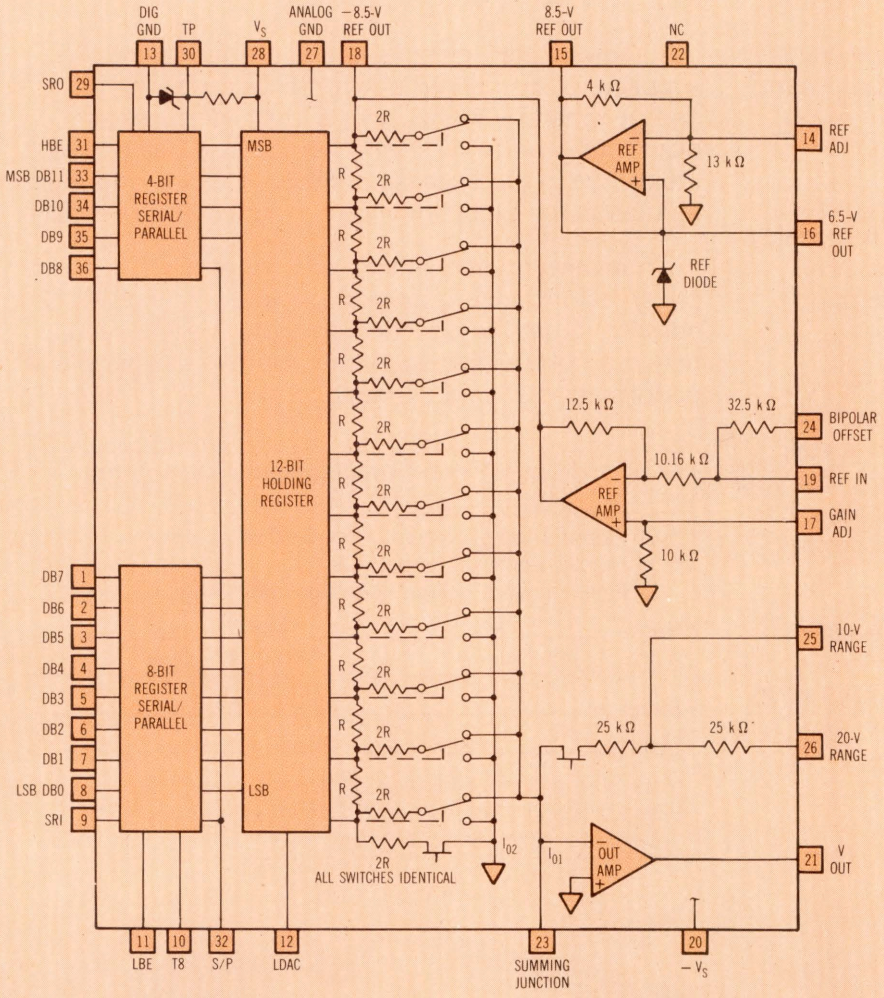
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Complete CMOS 12-bit DAC, 7581C, from Beckman utilizes programmable input registers for interface to 8-, 12-, or 16-bit microprocessor bus

Complete 12-Bit DAC Provides Compatibility To Microprocessors

A digital to analog converter of 12-bit resolution, the 7581C, offers input registers, an R-2R ladder network, switches and level shifters, a reference, and an output buffer amplifier, in a single package. Its manufacturer, Beckman Instruments, Inc, 2500 Harbor Blvd, Fullerton, CA 92634, claims it to be the first 12-bit CMOS DAC to combine versatile, low-cost DAC80-type analog circuitry with complete microprocessor compatibility. The programmable input registers provide the interface for either parallel or serial data transfer between the converter and 8-, 12-, or 16-bit microprocessor buses. External connections allow selection of standard output voltage ranges of 0 to 5, 0 to 10, ±2.5, ±5, or ±10 V.

The device can operate with power supplies ranging from ±12 to ±17 V, and can be driven directly by TTL or CMOS logic. Its CMOS design makes it appropriate for portable instrumentation and other applications where low power consumption is required.

As an additional feature, the converter provides access to voltage references of 8.5, 6.5, and −8 V for system use. Provision is also included to allow the user to adjust the 8.5-V reference and compensate it to be independent of power supply variations.

Double-buffered inputs facilitate 12-bit data word parallel loading from an 8-bit data bus. Two input registers accept the 12 bits of data from the microprocessor. Used in conjunction with an 8-bit data bus, each input register can be enabled separately to accept the 12-bit data word in 4-bit (MSB) and 8-bit (LSB) bytes. The 12-bit data word is then parallel loaded into a holding register and converted to its analog equivalent. Without the holding register, output transients would occur, due to the 2-byte parallel loading scheme. In conjunction with a 16-bit data bus, both input registers can be enabled simultaneously to accept a 12-bit parallel input data word.

True 12-bit accuracy exists throughout the operating temperature range. The ±½-LSB linearity spec guarantees

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See page 79

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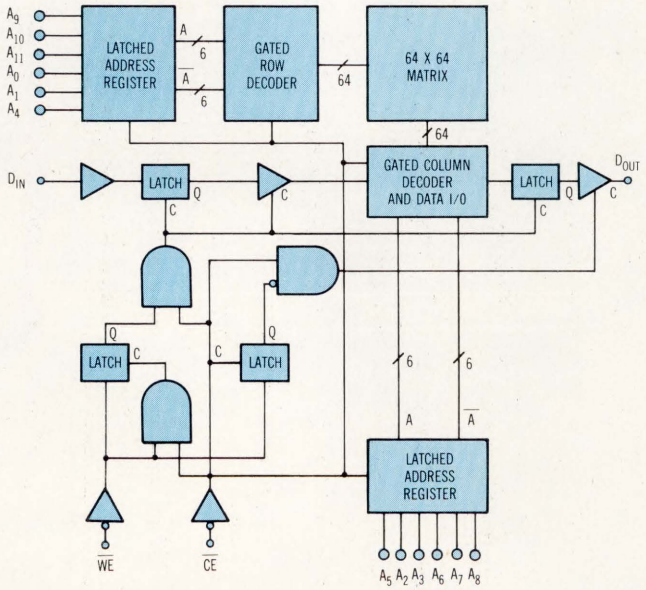


that each step in the output voltage staircase will be no further than ±½ LSB (max) from an ideal straight line between the output range end points (inputs all 1s and inputs all 0s). This specification also guarantees monotonic output. The differential linearity spec guarantees that each output staircase step will be 1 LSB ±½ LSB.

Additional features include 4-quadrant multiplying capability, ±0.002% FSR/%V supply rejection, and ±0.005% pretrimmed zero offset. Settling time (0 to 10 V) is 6.0 μs (typ) and includes switching time, current settling time at the summing junction, and output amplifier slew time, finally settling within 0.012% FSR of final value.

The DAC is priced at $24.50 in 100s and is provided in a 36-pin DIP. Maximum ratings require that the voltage from reference input to common lie between ±15 V and that ±V to common not exceed 17 V. The digital input voltage must stay between −300 mV and supply voltage, V_S. Allowable temperature ranges are 0 to 70 °C in operation and −55 to 100 °C in storage.

Circle 507 on Inquiry Card



Monolithic CMOS static RAM, OKI's MSM5104, organized as 4k x 1, operates at <33 mW/MHz, with standby power <200 μW. Memory can utilize battery backup

4k CMOS Static RAMs Accept Battery Backup

Two monolithic static random access memories, manufactured by OKI Semiconductor, 1333 Lawrence Expy, Suite 405, Santa Clara, CA 95051, provide a storage capacity of 4096 bits each. The CMOS devices, based on silicon gate technology, can utilize batteries as backup power sources. Power dissipation is less than 33 mW/MHz in operation and less than 200 μW on standby.

The MSM5104-2/3 is organized as 4k x 1 and the MSM5115-2/3 is organized as 1k x 4. Max access time is 200 ns for -2 versions and 300 ns for -3 versions. Features include direct TTL and CMOS compatible I/O, 3-state outputs, operation from a single 4- to 6-V power supply, and onchip address/data registers. Data are retained down to V_{CC} = 2 V.

Guaranteed for operation from 0 to 70 °C, the memories are offered in high density 300-mil 18-pin ceramic or plastic packages. The 4k x 1 RAM is pin compatible with the Mostek 4104 and interchangeable with the Harris 6504, while the 1k x 4 RAM is pin compatible with the Intel 2114 and interchangeable with the Harris 6514.

Absolute maximum ratings require that supply voltage, V_{CC}, remain between −0.3 and 7 V. Input voltage, V_{IN}, must stay between −0.3 V and V_{CC} +0.3 V, and output voltage, V_{OUT}, is constrained to a range from 0 to V_{CC}. The allowable storage temperature range is −55 to 150 °C.

Circle 508 on Inquiry Card

16-Bit DAC Is Implemented On Two Chips

A 2-chip digital to analog converter, the DAC 9331-16, is said by its manufacturer to be the first microcircuit DAC to provide 16-bit resolution and

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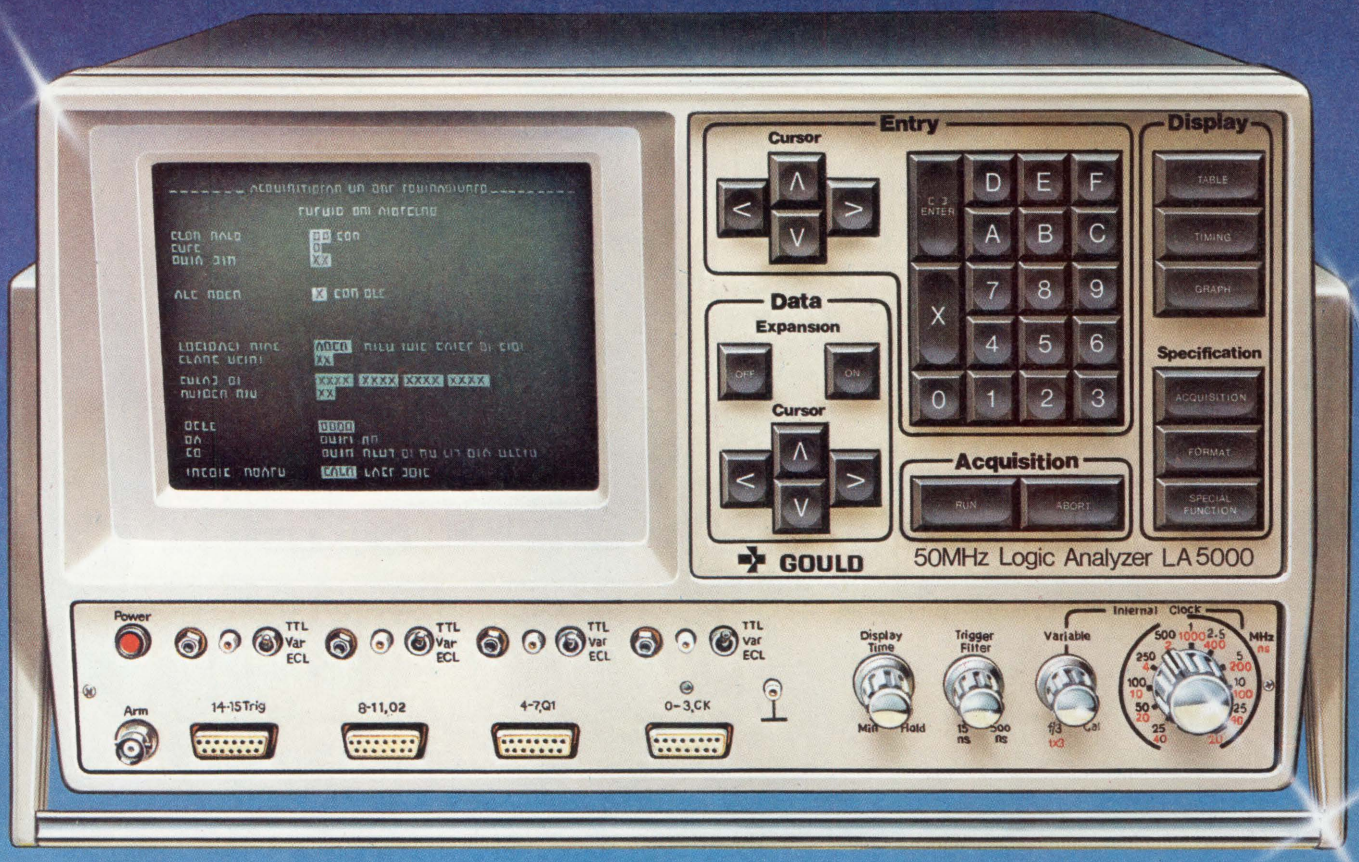
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Biomation's new LA-5000 50MHz logic analyzer brings the convenience of our K100-D to microprocessor designers.

Following our K100-D, which sets the industry standards for digital system debugging, Biomation brings you a new glitch fixer, the LA-5000. A logic analyzer matched in cost and capability to the needs of microprocessor system designers.

The LA-5000 is ideal for data domain and timing analysis with clock rates from 12.5 MHz with 16 recording channels, to 50 MHz with 4 channels. Three display modes give you: data domain information in binary, octal or hexadecimal; timing diagrams; even a graphic plot of successive word values.

Three full screen interactive menus—Acquisition, Format, and Special Function—make set-up fast and simple. There are also partial menus of frequently needed parameters as part of the display modes.

Convenience features? The LA-5000 features two memories with an auto-stop function to simplify fault-finding. Reverse video highlighting calls attention to memory differences. The reference memory is easily accessible via the keyboard. And, a memory search feature matches like sequences in both working and reference memories.

Introduce the glitches plaguing your system to their fixer. You'll enjoy efficient system debugging at a price well below what you'd expect to pay. For more information on the LA-5000, or any of Gould's full line of logic analyzers, write: Gould Instrument Division, Santa Clara Operations, 4600 Old Ironsides Drive, Santa Clara, CA 95050. Or call (408) 988-6800.

GOULD

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CIRCLE 135 ON INQUIRY CARD

accuracy. Produced by Hybrid Systems Corp, Crosby Dr, Bedford, MA 01730, the device maintains a ±0.0008% linearity over temperature.

One of the chips contains switches, input storage registers, and additional electronics needed for high accuracy performance. The second chip is a high precision, thin-film resistor network which uses dynamic laser trimming to achieve resistor accuracy and stability. Input storage registers in two 8-bit segments with independent latching facilitate microprocessor data bus interfacing.

Capabilities of the converter include 2- and 4-quadrant multiplication, settling in 2 μs, and a low scale factor drift of ±1 ppm/°C. The unit is both TTL/DTL and CMOS compatible, operates from a single 15-V supply, and consumes less than 60 mW of power. Input registers provide data storage when latched, or transparent registers when unlatched, so that data conversion can be performed continuously or from stored data.

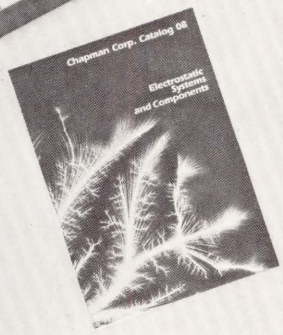
Reliability and low cost are emphasized for the 24-pin double DIP. Pricing is $99 in 100s or $169 in small quantities, with 4- to 6-week availability.

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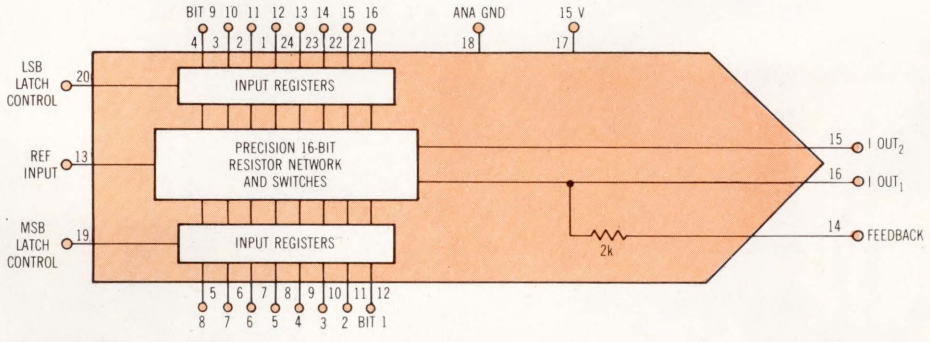


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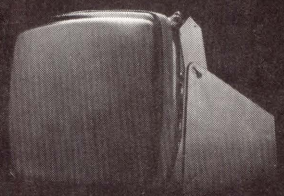


16-bit DAC from Hybrid Systems. Input registers will latch for data storage, are transparent when unlatched

A video bandwidth of 30 MHz and a 1200-line resolution make this new CRT monitor the brightest and sharpest you can get.

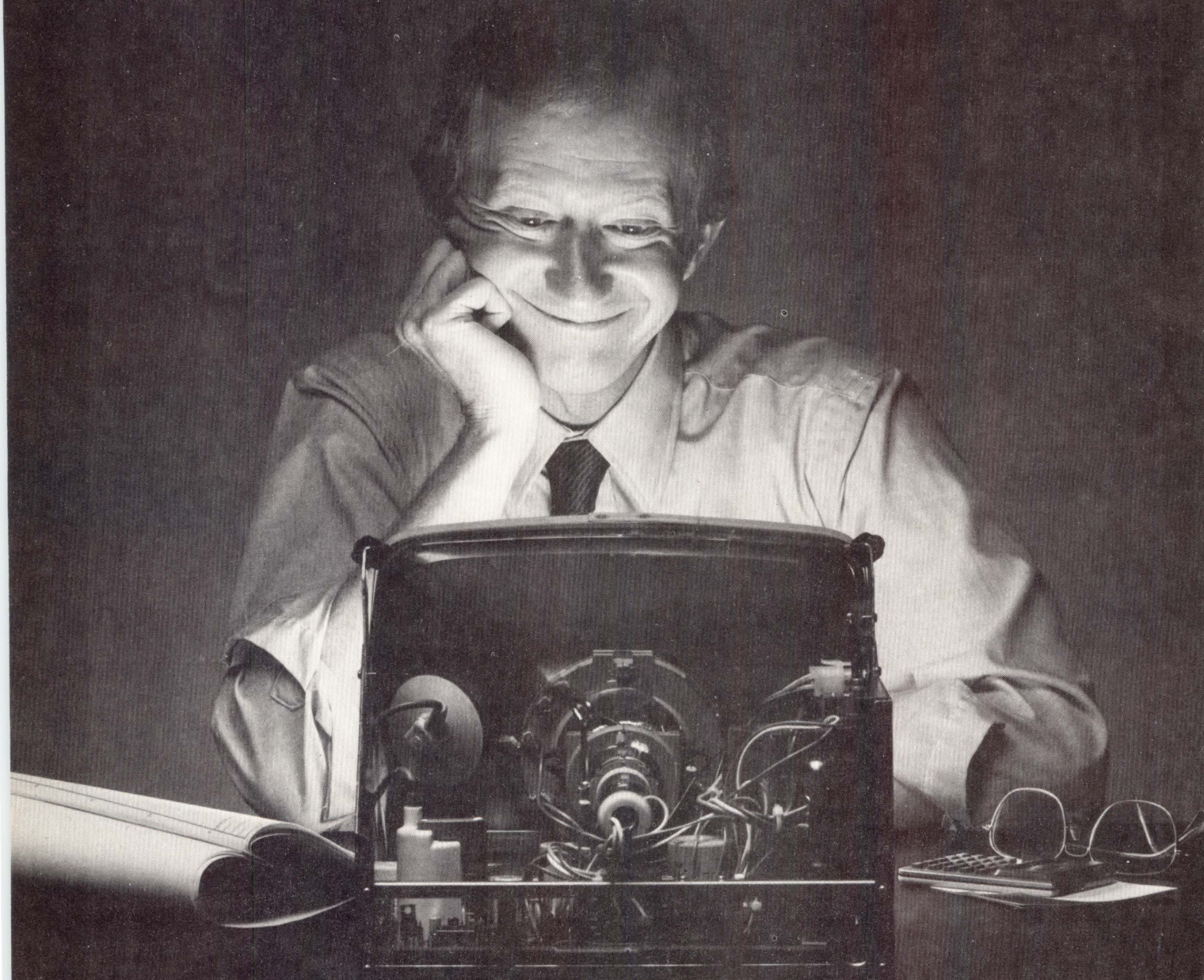
C. Itoh's new model 1201BE in our QDM series is capable of receiving separate horizontal drive pulse, vertical drive pulse and video input at the TTL level. This separate signal mode eliminates composite sync and video signal processing. The CRT is equipped with its own power supply unit. P4 phosphor is standard, but optional P31 or P39 phosphors can be provided. Available options: Dynamic Focus, Skip Scan, a non-glare etched face and a 19.5 KHz horizontal frequency.

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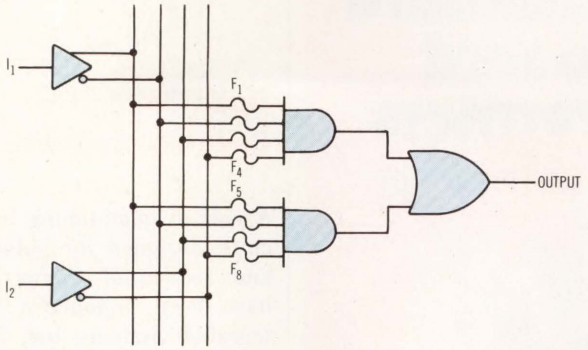
Programmable Array Logic Devices Reduce Chip Count

National Semiconductor Corp, 2900 Semiconductor Dr, Santa Clara, CA 95051, has begun sampling a series of programmable array logic (PAL) devices, using a Schottky TTL process and bipolar P/ROM fusible link technology to provide the user with programmable logic that replaces conventional SSI/MSI gates and flipflops. It is possible to reduce chip count by a factor greater than four. All devices in the PAL family are based on the use of a programmable AND array whose outputs feed a fixed OR array. Inputs and their complements are connected directly into a fuse matrix where they are combined to form product terms by selectively programming the fuse array. These product terms are then connected to the OR gates to form AND-OR logic functions of the input variables.

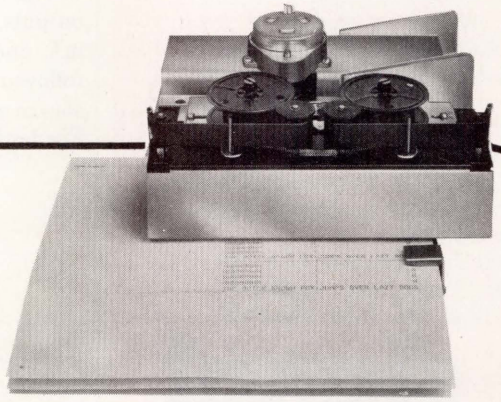
This sampling includes four specific arrays, classed as "medium PALs," each of which utilizes 16 inputs and either 8, 6, or 4 outputs. The DMPAL16L8 is an octal AND-OR-invert array, in which eight OR gates are connected to Tri-State® output buffers whose Tri-State controls also are field programmable. Registered AND-OR arrays being sampled include the octal DMPAL16R8, hex DMPAL16R6, and quad DMPAL16R4. These are connected to eight, six, and four D-type register elements, respectively, which, in turn, are connected to output Tri-State drivers. In addition, the register outputs are fed back into the AND array allowing the current state of the array, together with the input data, to determine the next state.

Input to output and register set-up times for the four arrays are 40 ns with a 25-ns clock to output register delay. These are maximum times over commercial temperature and voltage ranges.

The company plans to sample the chips throughout the first quarter of 1980 with production quantities scheduled for the second quarter. Pricing will be under $50 in quantity at production release, with price expected to drop rapidly as production volume increases throughout the year. The devices are manufactured under a licensing agreement with Monolithic Memories, Inc, the originator of the array family.



Section of programmable logic array (PAL) second sourced by National Semiconductor. AND gate array is programmable via fusible links, providing outputs that feed fixed OR array



Open For Business

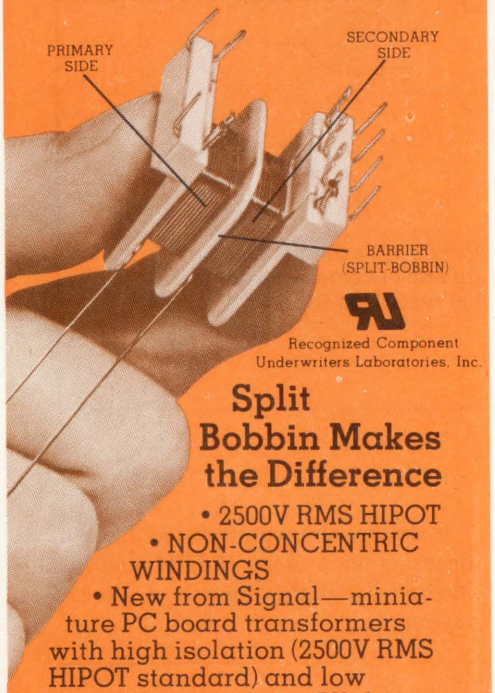
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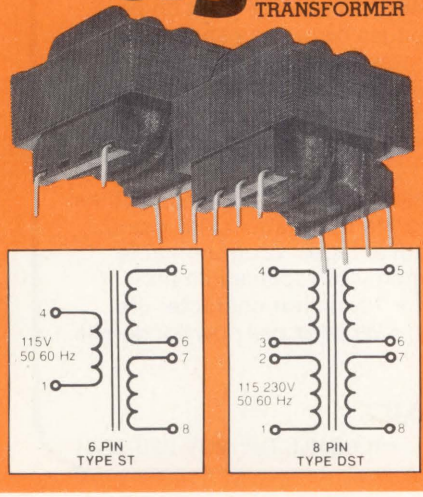


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CIRCLE 139 ON INQUIRY CARD

Quad-Timer ICs Save Board Space

A pair of quad-timing integrated circuits, designed for industrial control and sequential timing applications, have been announced by Exar Integrated Systems Inc, 750 Palomar Ave, Sunnyvale, CA 94088. They offer significant board space and cost savings over conventional IC timers. A characteristic common to both circuits is the acceptance of supply voltages ranging from 4.5 to 16 V.

Each of the monolithic devices contains four totally independent timer sections, any one of which can produce a time delay from microseconds to minutes, as set by an external RC network. Since the four sections share the same IC chip, their matching and temperature tracking characteristics are superior to those of single timer circuits.

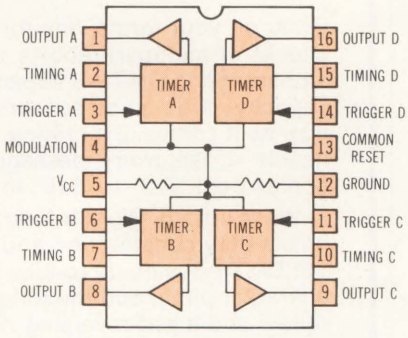
The XR-558 provides open collector outputs, each able to sink up to 100 mA, and the XR-559 provides emitter-follower outputs, each of which can source up to 100 mA of load current. For both models, outputs are ordinarily low, and go high during the timing interval. The output state is independent of trigger condition.

Both circuits are edge-triggered devices, allowing timer sections to be cascaded with other timer sections without the use of coupling capacitors. Each of the four timer sections has separate output, timing and trigger controls. All four sections, however, share a reset control.

These circuits are direct pin for pin replacements for the NE-558/NE-559 from Signetics. They are provided in 16-pin DIPs, with both plastic (suffix CP) and ceramic (suffix CN) packages specified for operation over the commercial 0 to 75 °C range. Ceramic packages (suffix -M) are also avail able for the military range of −55 to 125 °C.

Absolute maximum ratings limit power supply to 18 V. Maximum allowable power dissipation for ceramic packages is 750 mW, derated above 25 °C by 6 mW/°C. The corresponding limit for plastic packages is 625 mW, derated above 25 °C by 5 mW/°C. Storage temperature must remain between −65 and 150 °C.

Circle 510 on Inquiry Card



Exar's quad timing circuits, XR-558 and XR-559, contain four independent timing circuits on single chip. Each circuit is independent and can produce delay from microseconds to minutes

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If you're as concerned about your interconnect performance and costs as I am, you really ought to write Spectra-Strip, 7100 Lampson Avenue, Garden Grove, CA 92642, telephone (714) 892-3361. In the East, call (203) 281-3200.

But don't ask for Dave—he's at home taking care of the baby."

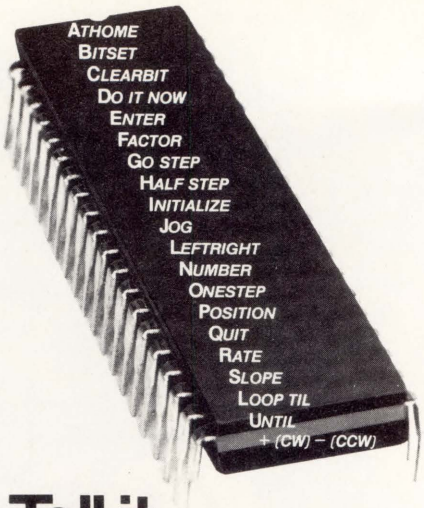
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The CY500 executes 22 hi-level instructions, either in command mode or as a sequence of internally-stored commands, using single byte code such as 'P' for position, 'R' for rate, and 'S' for slope. Parameter values can be expressed in ASCII-decimal for keyboard programming or binary code from the host computer. Parallel or serial communication.

The stored program capability allows the use of 'DO-WHILE' program looping and 'WAIT-UNTIL' operation. Ten different operational modes allow absolute or relative positioning, full- or half-step operation, hardware or software control of direction, start/stop, . . . and many more.

Numerous input and output control lines allow synchronizing the CY500 with external events or devices and allow each step to be triggered. Stepping at rates up to 3500 steps/sec, the CY500 also provides ramp-up, slew, and ramp-down operation, all under software control. Two interrupt lines request the host's attention if needed.

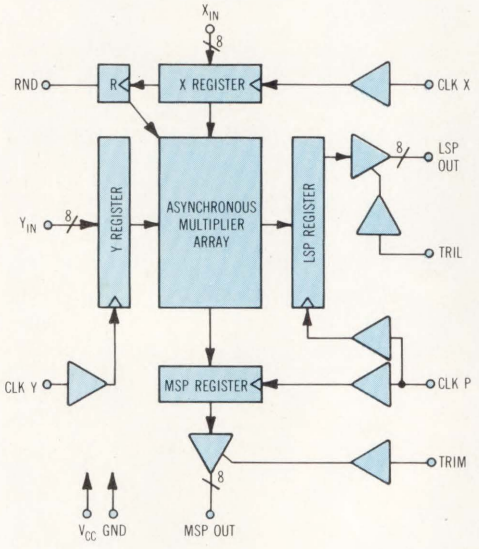
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AROUND THE IC LOOP

8 x 8 Multiplier Yields Double Precision Result In 45 Nanoseconds



Parallel array multiplier (MPY-8HUJ) from TRW LSI Products provides 8- by 8-bit multiplication of unsigned magnitude inputs for double precision product. Multiplication time is 45 ns

Operating on unsigned-magnitude inputs, a TTL LSI 8- by 8-bit parallel array multiplier from TRW LSI Products, 2525 E El Segundo Blvd, El Segundo, CA 90245, completes a multiplication in 45 ns to produce a double-precision product. The monolithic MPY-8HUJ finds applications in digital video signal processing and digital filtering. It is useful in extending the multiplication capabilities of microcomputers, since all the interface circuitry is included onchip except for the address and clock decoder.

Onchip I/O registers speed operations, reduce system overhead, and simplify microprocessor interfacing. These four registers are positive-edge triggered D-type flipflops with independent clocks.

The main internal multiplier array logic achieves a speed-power performance index of less than 0.8 pJ per equivalent gate. X and Y input operand registers hold data so that an associated system can perform other tasks while the product is being determined. These TTL-input registers interface directly with an 8-bit microprocessor system bus and have separate X and Y input clocks.

Products obtained from the asynchronous multiplier array are stored in two 8-bit registers, one for the least significant product (LSP) and another for the most significant product (MSP). A single-product output clock and two separate 3-state controls of the LSP and MSP result in an easy interface to 8-bit microprocessor systems. Also, this allows several multipliers to be used in higher speed pipelined systems.

Two models are available, both having the same typical multiply time at 25 °C. However, the standard version does not guarantee a maximum multiply time, whereas the MPY-8HUJ-1 guarantees a 65-ns max over the temperature range.

The device is capable of single-bus or multiport operation, and features radiation hardness and operation from a single 5-V supply. It uses much less power and space than MSI equivalent multipliers. Power dissipation (typ) at 25 °C is 1.2 W. The multiplier is provided in a 40-pin ceramic dual-inline package. Circle 511 on Inquiry Card □



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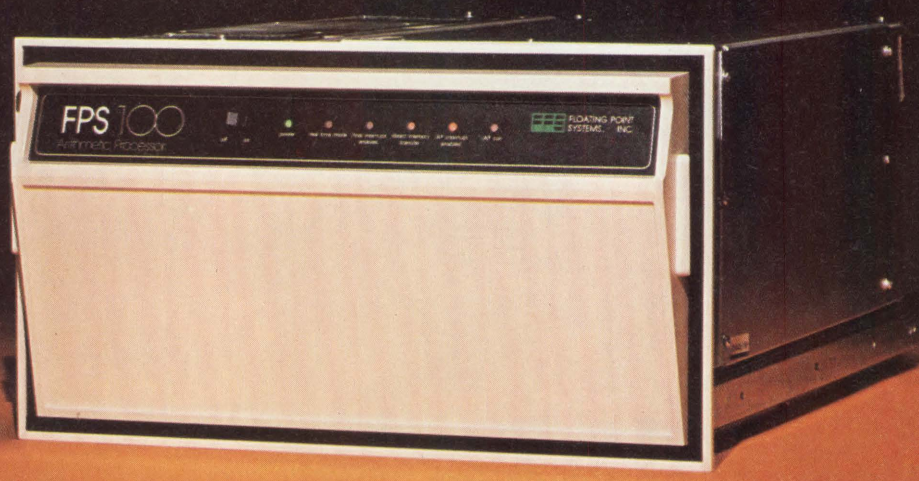
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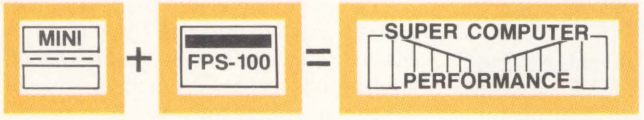
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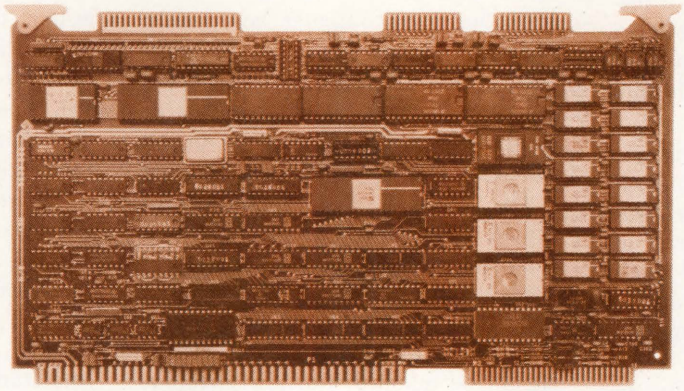
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PRODUCT FEATURE

MULTIBUS Compatible Microcomputer Board



With Onboard Floppy Disc Formatter/Controller

Incorporating an onboard floppy disc formatter/controller in addition to two serial ports, the MSC 8009 single-board microcomputer, designed and manufactured by Monolithic System Corp, is directly compatible with the standard MULTIBUS.* The computer's 8080 software compatibility provides an advanced high speed system without incurring the cost and delay associated with developing new software, while the integral floppy disc controller allows interface with 5 or 8″ disc units in any mix of single or double sides as well as double density. Provision of serial ports offers high speed links to peripherals such as CRT or printer as well as communications with other machines or systems. Full MULTIBUS control logic permits up to 16 bus masters to share the system bus. A user can program one of three bus modes to exchange the bus master every cycle, every instruction, or when required at the end of the software routine.

The microcomputer uses the 4-MHz Z80A microprocessor as the central processing unit. Existing Z80 software and 8080 board software can be used with minimum modification. In addition, an optional arithmetic processing unit—either the Am9511 or Am9512—allows arithmetic and transcendental functions as well as control and conversion commands to be performed at higher speeds than comparable software techniques, without consuming memory space to store the routines. The Am9511 provides 32-bit precision fixed or floating point operations including transcendental functions. For increased performance, the Am9512 offers single-precision 32-bit and double-precision 64-bit add, subtract, multiply, and divide operation. The unit is compatible with the proposed IEEE floating point format. As a result new systems can be designed taking full advantage of the Z80A instruction set and the optimal floating point arithmetic unit.

Operating in a multimaster system with either parallel or serial priority resolution, the microcomputer's internal bus plus the MULTIBUS structure allows other operations to proceed on the MULTIBUS while the Z80A processor uses local memory and I/O devices. Since the onboard memory and I/O resources are extensive, bus access is usually needed only for communication between tasks. System throughput with multiple masters is greatly enhanced because of the light MULTIBUS traffic load. MULTIBUS compatibility allows the microcomputer board to be used for expansion of existing SBC-80 based systems or as the basis for a new system design. This microcomputer can also operate in a stand-alone configuration with a CP/M** software system.

*MULTIBUS is a trademark of Intel Corp

**CP/M is a trademark of Digital Research Corp.

Design Features

In the basic system, a dynamic RAM provides up to 32k-bytes storage capacity. A 16-chip memory array is partitioned into two 16k-byte sections. Either the address lines of the Z80A microprocessor or the MULTIBUS (direct memory access) address these arrays. Memory refresh cycle is automatic and essentially transparent. The refresh cycle is hidden in order to allow requested memory operations to be performed with minimum delay time. If either a memory read or write operation of the RAM is in progress, the refresh cycle is inhibited. When the memory cycle is completed, a refresh cycle can be initiated. The refresh control logic attempts to initiate a refresh during an M1 machine cycle, making the refresh transparent. However, if an M1 cycle is not available, the refresh is still inserted.

Four sockets accommodate most current 8-bit wide, 24-pin ROM/EPROM devices. These devices normally hold the commonly used subroutines, standard support software, and programs for specific applications. By using the 2708 and 2758 (1k x 8 EPROMs), the microcomputer board can provide up to 4k bytes of program storage; 2516 or 2716 (2k x 8 EPROMs) provide 8k bytes, while either 2532 or 2732 (4k x 8 EPROMs) allow 16k bytes of storage. For 32k-byte capcity, 8k x 8 masked ROMs can be used. 450-ns devices are required for 4-MHz processor-clock operation.

Since each ROM/EPROM device may vary in power requirements, hard wire jumpers provide the required voltages. Different chips may be intermixed, but three of the four sockets must contain the same devices.

A bipolar, fusible-link P/ROM defines the memory address and I/O structure for the microcomputer. Jumpers and switches have been eliminated to increase reliability and provide more flexibility in memory allocation. Any memory device may be assigned to start on any 256-byte boundary in the 64k addressable space. However, if care is taken to avoid overlapping device addresses, the address-decoder P/ROM contents can be reprogrammed to satisfy even the most unusual memory or I/O address mapping requirements. Two complete address maps may be stored in an optional extended P/ROM.

A special P/ROM is used to protect any or all RAM, ROM, or I/O subsystems from external access. This device generates an internal enabling signal that permits the bus to address the microcomputer board only when called for. A pin on the auxiliary connector totally disables access to the microcomputer board, allowing multiple processors to be paged into the same memory space.

The optional dual map feature provides the microcomputer with two complete address maps. The system always powers up under the first map. Because a ROM at location zero is required to start properly, a ROM should be mapped into low memory. This capability allows the use of software written for 8080 and Z80A microprocessors that previously could not be run on single-board computers.

Vectoring for eight levels of priority interrupt in addition to a nonmaskable interrupt is provided. Because all onboard interrupt sources are open collector, a number of devices can share the same level. Three operating modes and priority assignments can be configured any time during system operation via software control.

Nonmaskable interrupt gives the user a method for dealing with power failure or for diagnosing certain hardware and software problems. A power-fail service routine can be added to an existing SBC-80 program without making major changes because the nonmaskable interrupt functions independently of existing hardware.

Using a 1793 formatter/controller device, the floppy disc interface provides a soft sector format that can be made IBM compatible with the proper software. Single- or double-density and double-sided drives can be connected to the system and controlled by the software. The system uses Z80 block I/O instructions to transfer data. Up to eight 5 or 8″ (12.7- or 20.3-cm) drives can be intermixed within the system. Write precompensation is provided to reduce error rate, and the data separator is crystal controlled. Programmable stepping rates allow the microcomputer to operate with drives having different track to track access times.

The two serial ports are designed around software programmable devices—the 8251 universal synchronous/asynchronous receiver/transmitter (USART) and an 8253 programmable timer. Both channels can be configured for either EIA RS-232-C or TTL operation only; whereas only one channel can provide 20-mA current loop operation.

The user's program selects the desired mode of operation, data format, control character format, parity, and baud rate. The USART provides full duplex, double-buffered transmit and receive capabilities. Parity, overrun, and framing mirror detection are also incorporated within the USART. One section of the programmable timer supplies the baud rate clock under program control to all channels optionally, or additional sections can be used for different baud rates on the other serial channels. Most of the microcomputer logic is synchronous with a 16-MHz master clock (K1115A) device, which is used to drive the 8-MHz bus clock. Additional independent system timing functions include power up, initialization, and a watchdog timer.

The microcomputer board operates with power supply voltages of ±5 and ±12 V to match the MULTIBUS. Physical dimensions are 12″ (30 cm) long x 6.75″ (17.15 cm) wide x 0.5″ (1.27 cm) high.

Price and Delivery

Single-quantity price for the MSC 8009 single-board microcomputer with 32k bytes of RAM and full I/O (floppy disc controller and two serial ports) is $1895. OEM quantity discounts are available. Typical delivery is 30 days ARO. Monolithic Systems Corp, 14 Inverness Dr E, Englewood. CO 80112. Telephone: 303/770-7400.

See at NCC Booth 1743

For additional information circle 199 on inquiry card.



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We are looking for dynamic individuals with creative energy and untapped potential, who know mini's inside and out, and are as comfortable with a coding sheet as a logic template, and recognize the aesthetic subtleties of a computer system's design. GO TO 10!

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20: Do you have a BS in EE or Computer Science (or a convincing reason why you don't need one)? If you recognize true creativity in systems design, and are looking for what may be the most productive, most challenging and rewarding position of your career, GO TO 30, 40, or 50.

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40: Do you have 3-5 years of experience with mini's, software design, hardware design, data communications, industrial applications, and real time systems? Do you have "smarts" in one or more of the above, and the project experience to prove it? (Ability to assume full project responsibility is a real plus.) If you have one of these, you'll have the time of your life!

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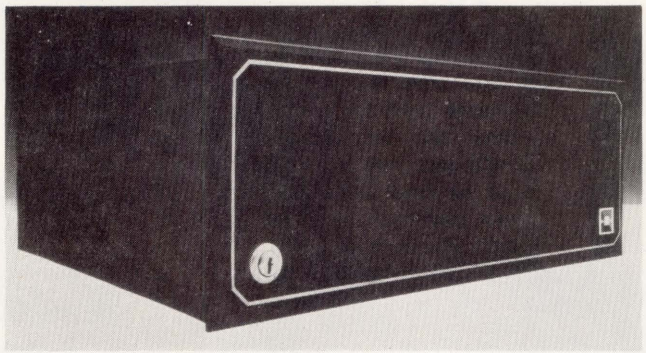
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CIRCLE 144 ON INQUIRY CARD

PRODUCTS

Self-Contained Backend Processor Provides Complete Database Management System



IDM (Intelligent Database Machine) 500 integrates hardware and software in a rackmountable enclosure for connecting combinations of host computers, OEM programmable terminals, and industry standard disc drives. The database management system is based on the relational model of data, which organizes the data as simple tables. Multiple data bases of up to 32G-bytes total capacity with transaction rates of 2 to 25/s are supported. The host computer independent design also provides data independence between the data base and application programs.

Similar to a communications frontend, the dedicated peripheral does not use host resources; it offloads a specific host task, giving several hosts simultaneous access to a common data base. Features include transaction management, concurrency control, protection, backup, and recovery. Additional capability includes stored queries, custom views of the data base, random access file system, and nonprocedural access to data. Using special purpose hardware, the system processes data at disc transfer rates of over 800,000 bytes/s. Parallel and pipelined processors operate at speeds up to 10M instructions/s.

Communication to the system takes place using a binary representation of the database command. High level languages are supported by embedding a query language in any programming language or by building a subroutine library. High level query language IDL™ (Intelligent Database Language) is available, or the user may employ it to develop an application specific language. Base configuration is the database processor, memory controller and array board (256k bytes), SMD disc controller, and serial or parallel I/O option. Available options are a database accelerator which typically improves performance by a factor of 10; 128k- and 256k-byte memory array boards; 8 serial I/O lines, RS-232-C asynchronous, 19.2k baud max; GPIB parallel I/O, 250k bytes/s max; and SMD disc controller, each of which supports 4 additional drives. **Britton Lee, Inc,** Albright Way, Los Gatos, CA 95030.

Mini-Floppy Compatible Winchester Disc Drive Impacts Microcomputer With More Storage

Physically compatible with the industry standard mini-floppy and using the same 12 and 5 Vdc, the ST500 is a 5.25″ (13.34-cm) micro Winchester disc drive that offers approx 15 times more capacity. The sealed, nonremovable discs, packaged in an airtight enclosure with integral air filter, feature increased reliability as well as increased bit and track densities. Requiring no ac power, the drive dissipates 30-W heat. In addition, the main element that limits track expansion and contractions of the disc resulting from heat has been reduced by using the base casting to dissipate heat through fins designed into the casting.

The Shugart Associate SA1000 interface has been adopted for similarity among systems, requiring only a few modifications to handle either type of disc drive. A single controller can be designed to handle the ST500 and floppy disc drives for backup and I/O. Six mini-floppy discs can backup the micro Winchester; size, interface, and voltage similarities suit this architecture combination to low cost system designs. Other backup methods are tape cartridges, streaming tape drives, or additional Winchester disc drives.

The 3.25 x 5.75 x 8″ (8.25 x 14.61 x 20-cm) package stores 6.38M bytes unformatted, with 1.59M bytes/surface and 10,417 bytes/track. Formatted capacity is 5.0M bytes/drive. Access times are 170 ms avg, 3 ms track to track, and 500 ms max. Transfer rate is 5.0M bits/s. Data are recorded on the discs at approx 7500 bits/in (2953/cm). Drive mechanics are broken into 2 motor assemblies (stepper and spindle), a head assembly with 4 Winchester heads, and disc assembly with 2 discs (OD is 130 mm, ID is 40 mm). Electronics are carried on 2 PC boards. The stepper motor uses a steel band to position the heads over 153 tracks. The spindle is driven by a dc brushless motor that spins the discs at 3600 r/min. The motor controls the speed at ±1% to ensure data integrity. **Shugart Technology,** 340 El Pueblo Rd, Suite C, Scotts Valley, CA 95066.



At NCC, see at Registry Hotel, Orange County Airport
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THE MOST FIELD PROVEN IS NOW THE MOST VERSATILE.



Telex introduces the new Tri-Density 6250 Tape Subsystem for OEM's.

In 1978, Telex introduced and delivered the first high speed 6250 BPI tape transport for OEM mini-computers. It lets you compact more data. In less space. At faster speeds. Since then we've built up more field proven reliability than any other 6250 OEM tape drive manufacturer.

Now this rack-mounted 6200 Series tape family has been expanded to include the 6253 tri-density tape subsystem. The high performance drive and formatter combines three densities—6250 BPI (GCR), 1600 BPI (PE), and 800 BPI (NRZI)—into a single unit. And as with all 6200 models, tape speeds of 50, 75 or 125 IPS are available. Telex formatters attach up to four 6200 Series drives and up to eight with an expansion option.

One key to the reliable operation of the 6200 Series is our patented Supr-Lite™ Capstan. It weighs only 1.9 grams, and combined with our patented new tape path, lets us use a smaller, more efficient drive motor. Tape handling at high program rates is improved.

Most importantly, the 6200 Series now offers you extreme versatility in matching and field converting a wide range of features and system options. The 800/1600 BPI dual density model 6240 can be easily field upgraded to tri-density. And such options as a 360/370 channel adaptor, high altitude and seismic feature, and dual speed capability will enhance your system configurations and performance many times over.

For more information about the 6200 Series—including its price/performance competitiveness—call your nearest Telex OEM representative. Or phone our OEM Marketing Department in Tulsa at (918) 627-1111.

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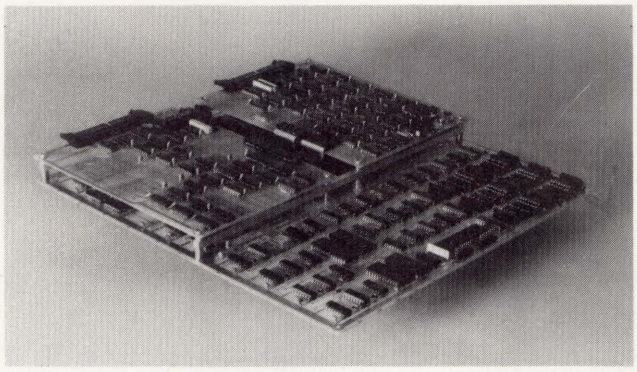
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CIRCLE 145 ON INQUIRY CARD

PRODUCTS

Storage Control Unit Accepts Drive Types With Different Data Rates



Packaging of the Intelligent Storage Control Unit (ISC) 4000 for mini and microcomputers allows the user to interchange drive types without replacing the control unit. The microprocessor controlled system supports up to 4 fixed discs and 4 backup devices such as industry standard flexible discs and high density cartridge tapes. The bipolar microprocessor handles data transfers on a byte basis. The controller scans data on the disc and makes data and address dependent decisions rapidly. Simultaneously supporting the SA4000 and SA800/850, the unit has a powerful command set and general purpose interface with DMA data transfer. A 2048-byte buffer serves the system channel and disc data transfers concurrently, handling the differences in data rates between high data transfer speeds of Winchester discs and slower system channels. Data at any rate up to 2.5M bytes/s may be processed.

Device related electronics are packaged on small PC boards, or device string adapters, which mount on the control processor. The system can attach 2 device string adapters, each of which supports up to 4 devices; thus, the designer can second-source disc drives and use a common control unit interface. The adapter supports single and double density, which can be changed on a dynamic basis under program control. Overlap on disc seeks and tape motion on all drives in the system are provided. All read, write, and scan data commands can implement implied seeks and multisector operations. Both fixed and flexible discs can be initialized with powerful format commands. Power-on microdiagnostics and extensive parity checking and data path checking are featured in the design. Data integrity is ensured by the implementation of a 48-bit error correction code on the fixed disc, and alternate sector and track management. A range of host adapters such as the S-100 bus adapter running with CP/M are expected to be supported. **Data Management Labs, Inc,** 4010 Moorpark Ave, Suite 215, San Jose, CA 95117.

Circle 202 on Inquiry Card

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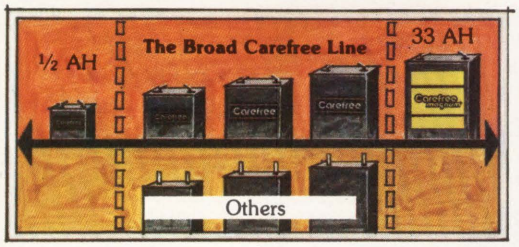
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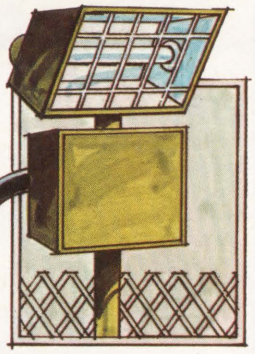
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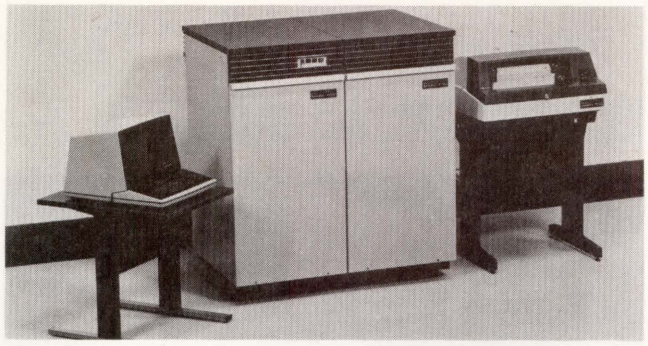
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PRODUCTS

Minicomputer Offers Program Compatibility With Large Data Processing Systems



With performance approximating that of an IBM System/370 model 138 computer, the 4000 Information System is software equivalent to the System/370, providing the user with access to its large library of software. System control programs, program products, and application programs can run on the minicomputer without changes. The minicomputer system is complete with processor, controllers, and peripherals. Included are disc drives, magnetic tape drives, card readers, CRT terminals, and character and line printers. A 32-bit architecture uses a high speed bus with multiple microprocessing units, microcoded to emulate IBM 370 channels and controllers.

Choice of redundancy or backup capability is available on a modular basis as required. The redundancy feature enables the system to meet ultra high reliability requirements of online transaction processing environments. Full redundancy is offered and any 1 or all of the modules of the system can be duplicated. These added modules enhance system performance when they are not required as backup capability and keep the system operating reliably with only minimal degradation when a failure occurs.

A separate service control processor for added reliability performs diagnostics on all system modules, checking their condition each time the system is started and monitoring them while the system is running. A remote diagnostic feature provides for hardware and software maintenance from a central control location. Also featured are solid state error correcting memory, sealed disc Winchester technology, low power components, and LSI circuitry. The system accommodates DOS/VS, OS/VSI, and VM/370 operating systems. Transaction Management System (TMS) runs under VM/370 and is tailored for a terminal oriented, database management environment. A business programming language similar to PL/1 has been added to the operating system. **Formation Inc,** 823 E Gate Dr, Mt Laurel, NJ 08057.

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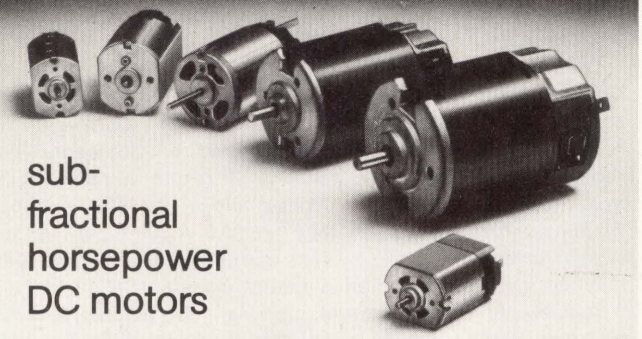
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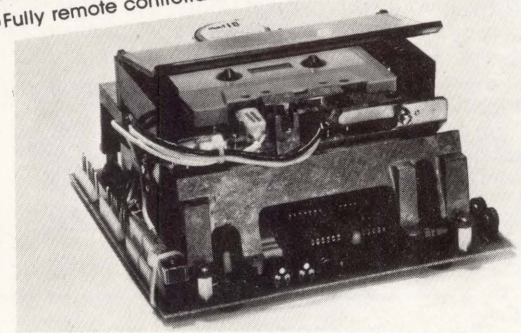
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Triple i Incorporated

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PRODUCTS

DEC Compatible Floppy Disc System Automatically Identifies Diskette Media Format



F02SYS floppy disc system, designed for users of LSI-11, -11/2, or -11/23 microcomputers with extended memory, is software, hardware, and media compatible with the DEC RX02 floppy disc system, with the added feature of being able to identify whether a diskette is single- or dual-density (DEC RX01 or RX02 formats). A guessing algorithm rather than an encoded sector byte is a more universal approach to density recognition. The system can also identify a companion disc drive as 1- or 2-headed to establish correct stepping rate and other control signals.

A dual-width, Z80 based controller card, 2 single- or dual-sided floppy disc drives, power supply, cables, and enclosure comprise the system. Both DEC RX02 diagnostics and on-board self-diagnostic tests can be run. Diagnostic programs include drive, interface, and data reliability tests. The Z80 microprocessor executes self-tests via internal firmware at power-up. Controller diagnostics consist of ROM check-sum test, RAM test, as well as interface register and drive bus access tests. A 512-byte hardware bootstrap is built into the controller LSI-11 interface section. The bootstrap program loads system software automatically from either single- or dual-density diskettes and eliminates the need for a separate bootstrap board; thus, a complete LSI-11 system supporting RT-11 can be configured in 4 Q-Bus slots. The bootstrap program also adjusts automatically for either RX01 or RX02 mode operation, and can provide several diagnostic functions for system self-testing.

Other features include I/O for single- or dual-head drive support, DEC Q-Bus interface, DMA interrupt logic, and a phase-locked loop for FM and MFM recording techniques. As an RX02 emulator, the system supports both single- and dual-head versions, and reads and writes single- and double-density data on IBM 3741 type diskette media. Also in this mode, the LSI-11 Q-Bus interface for the system transfers data via DMA. **Advanced Electronics Design, Inc,** 440 Potrero Ave, Sunnyvale, CA 94086.

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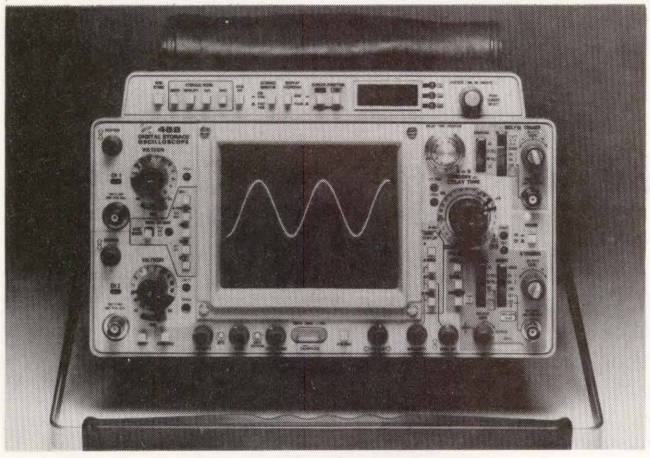
PRODUCTS

Digital Storage Oscilloscope Increases Engineering Productivity

Model 468 increases digital storage bandwidth limits, detects aliased signals, and corrects envelope error and display jitter; problems encountered with earlier digital storage equipment. In nonstorage mode, the instrument has all capabilities of 465B 100-MHz portable oscilloscope. In storage modes, selected by pushing a button, it continues to drive like a nonstorage unit and operates like a 465B. There are no storage level/intensity control interactions, and the stored waveform does not bloom or fade positive. This, along with signal averaging and cursors for time and voltage differences, make operation convenient for the user.

The unit has a 25M-sample/s, 8-bit digitizer and uses a display interpolation technique to achieve a 10-MHz useful storage bandwidth which permits the unit to perform faster than other storage scopes and increases range of signal frequencies that can be stored and displayed. The concept is based on digitizing rate and display type used and asserts that it takes more dots to define a waveform than when dots are jointed by vectors. The interpolated display requires only 2.5 samples/cycle to accurately display sinusoidal signals and achieves a useful storage bandwidth of 10 MHz.

Envelope mode uses dual sampling rates and records max and min values of a waveform envelope into memory over a selectable number of sweeps (2 to 256, plus continuous setting). It can capture narrow pulses on long sweeps and is useful for glitch catching, viewing waveform excursions, and detecting aliasing. The jitter correction circuit corrects for the ±½-sample interval shifting of a waveform that is caused by the asynchronous relationship between the trigger point and sample clock. The 1024 word data memory can store up to 2 x 512 word waveforms or 4 x 256 word waveforms. Internal service routines check performance and an optional ROM supplies additional service routines. **Tektronix, Inc,** PO Box 500, Beaverton, OR 97077.

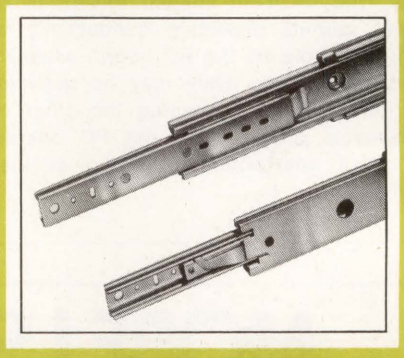


At NCC, see Booth 2327

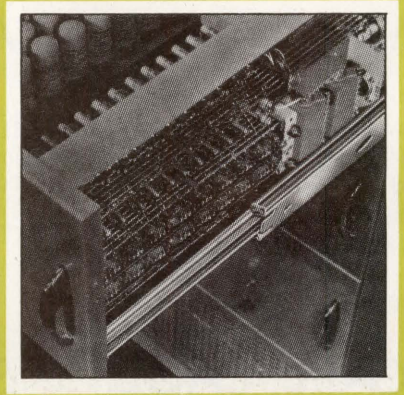
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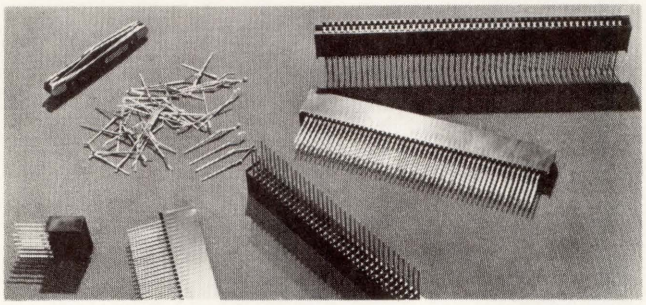
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CIRCLE 152 ON INQUIRY CARD

PRODUCTS

Stored-Energy Press-Fit Card Edge Connectors Eliminate Soldering And Wirewrapping



Discrete card edge connectors feature a compliant "stored energy" system for communications and data processing implementations. The crescent shaped design of the connector's contacts permits maximum conductivity with the entire plated through hole on the PC board, while maintaining plating surface integrity. They may be individually replaced without disturbing or damaging the other contacts. Conventional contacts pressed into the PC boards cause stress in the board and potential skiving of the solder plating at 4 points.

The compliant contact in the assembly provides individual contact replacement without disturbing or damaging the other contacts on the PC board or back panel. Any standard PC board may be used. The 1-piece configuration enables it to withstand normal press-fit forces when being inserted by a special connector assembly seating tool. This mounting technique reduces alignment problems and helps to eliminate potential reliability problems. In addition, the development eliminates soldering and wirewrapping steps.

The AK series has a 0.100 x 0.200″ (0.254 x 0.508-cm) grid and the AL series has a 0.125 x 0.250″ (0.318 x 0.635-cm) grid. Both series come with infinite contact positions. They are available with both ends of the card slot closed, both ends of the card slot open, or one end of the card slot open and one end closed, allowing the user to select any number of contact positions for specific applications. The connector insulator material is a polyester thermoplastic which meets UL 94 VEO requirements. Contacts are fabricated from CDA 725 alloy and are available with selective gold plated contacts. Modular components in the family are designed to be stackable to accommodate a variety of back panel requirements. **General Telephone & Electronics Corp,** One Stamford Forum, Stamford, CT 06904.

Circle 206 on Inquiry Card

MORE LSI-11 PRODUCTS
FROM ANDROMEDA

MEMORY
MEM11

32K × 16 — Fast enough for 11/23 CPU's — 18 bit addressing standard — 1K word increments — first and last address switch selectable — byte parity and 22 bit addressing optional — dual width card — fully socketed memory array

PARALLEL I/O
DIO11

64 TTL I/O lines — inputs and outputs individually selectable — dual width card — user kludge area — same connector pinout as 1664 TTL

DOUBLE DENSITY
DFDC11

An original, not a copy — controls up to 4 regular and 4 mini floppy disk drives — single and double headed — dual width card — 25% more storage and 2.46 times faster than DEC RXV21 — RT-11 compatible handler software available

8 X 4 CARD CAGE
8LCC

Replacement for MLSI-BPA84 — bifurcated, tapered entry, gold plated connectors — color coded card guides — choice of power connector — optional BCV compatible expansion connectors on backpanel — optional termination resistors

SOFTWARE

VEDIT — Video text editor for use with VT52, VT100, ADM-3A, and Hazeltine 1500 series

DPS — Document Processing System — formats, justifies output to any RT-11 device — takes advantage of most daisy wheel printers

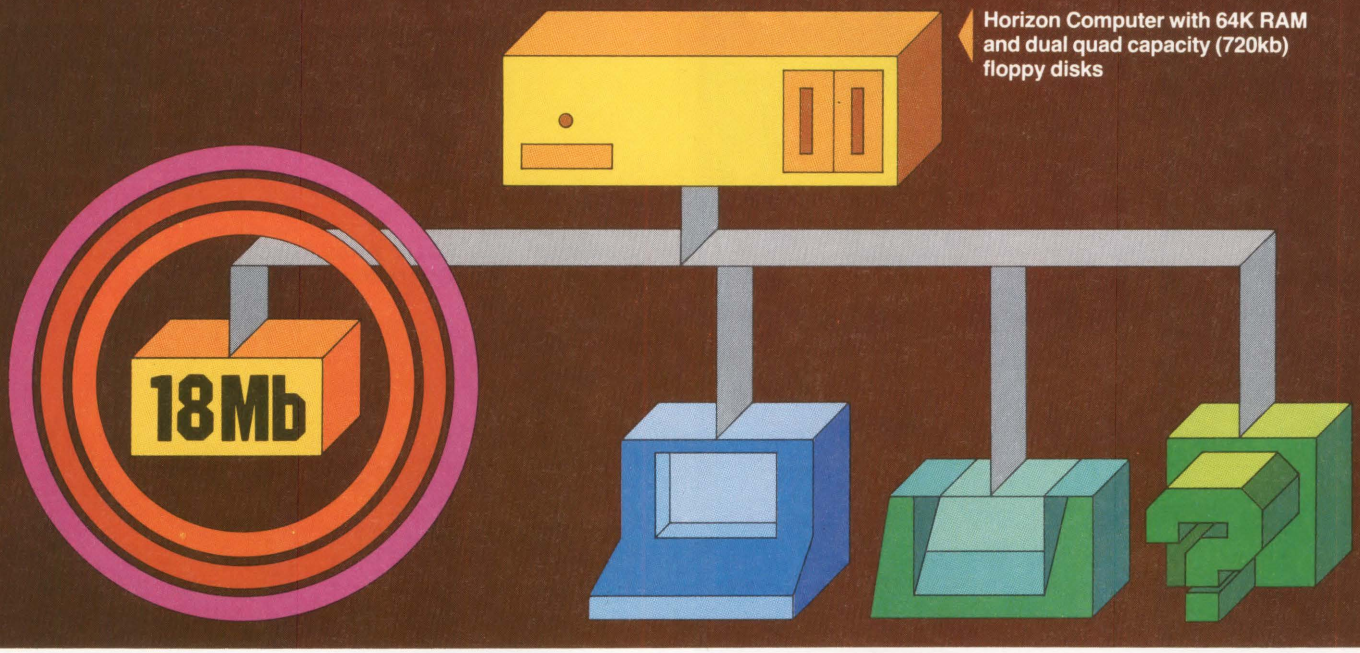
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The Horizon's success to date has been built on the quality of its system software (BASIC, DOS, PASCAL) and the very broad range and availability of application software. This reputation continues with our new hard disk system. Existing software is upward compatible for use with the hard disk system. And, with the dramatic increase in on-line storage and speed, there will be a continually expanding library of readily available application software. For further information, contact the OEM sales department at North Star Computers,Inc.

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HORIZON-HD-18 Horizon computer with 64K RAM, 2 quad capacity mini drives and one HDS-18 hard disk drive **$5880***	**HDS-18** Additional 18Mb hard disk drive for expansion of Horizon HD-18, or your present Horizon **$3150***

*in OEM quantities

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CIRCLE 154 ON INQUIRY CARD

BW-2630 Battery Tool



BW-2630 $19.85*
BT-30 $ 3.95*
BT-2628 $ 7.95*

BW-2630 BATTERY TOOL

The new BW-2630 is a revolutionary battery powered wire-wrapping tool. The tool operates on 2 standard "C" size NiCad batteries (not included) and accepts either of two specially designed bits. Bit model BT-30 is for wrapping 30 AWG wire onto .025" square pins ; BT-2628 wraps 26-28 AWG wire. Both produce the preferred "modified" wrap.

Designed for the serious amateur, BW-2630 even includes both positive indexing and anti-overwrapping mechanisms – features usually found only in industrial tools costing five times as much. Pistol grip design and rugged ABS construction assure performance and durability. In stock at local electronic retailers or directly from

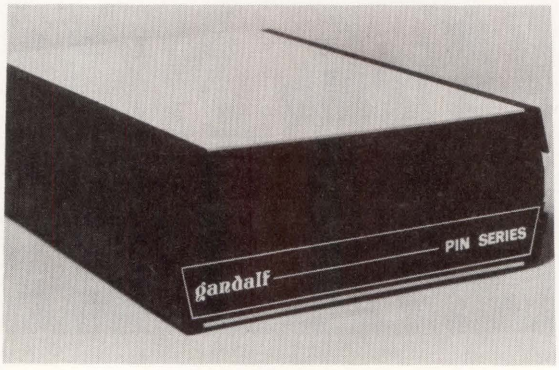
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3455 Conner St., Bronx, N.Y. 10475 U.S.A.
Tel. (212) 994-6600 Telex 125091

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272 CIRCLE 155 ON INQUIRY CARD

PRODUCTS

Statistical Multiplexer Adds Advanced Diagnostic And Operational Aids



S-MUX 9103 is an intelligent data concentrator that permits up to 32 asynchronous data links to be replaced by eliminating multiple data links and modems, and by concentrating the data onto a single high speed link. Synchronous link can operate at up to 19.2k bits/s with full error detection and recovery. Based on a microprocessor hardware architecture, the multiplexer combines high speed processing, direct memory access, 16k bytes of RAM, and 16k bytes of ROM. The unit automatically collects statistics of traffic volumes, error events, and buffer usage to keep track of channel usage and overall performance.

Diagnostics capabilities fully test all equipment functions plus individual channels while the system is online. Additionally, an English language configuration protocol enables users to enter commands into the unit's microprocessor via the terminal keyboard. Total terminal handling flexibility includes 3 types of flow control, null and line feed insertion, local echo, and 4 full-duplex EIA control signals/channel. A buffer with a 12,000-char capacity provides peak-load smoothing and immunity to line-hit disturbances. An adaptive line protocol provides efficiency of 115% under heavy load conditions, with only 25-ms throughput delay under light load conditions.

Also included are inter-multiplexer flow control and dynamic buffer allocation, ARQ line error protection, auto-baud speed control plus dial-up modem interfacing, full battery protection against parameter loss due to power failure, and automatic downline loading of all terminal parameter selections. The multiplexer can be configured in an 8-channel standalone version or in increments up to 32 channels per rackmount configuration. Asynchronous input rates from 50 to 9600 bits/s are accepted. **Gandalf Data, Inc,** 1019 S Noel Ave, Wheeling, IL 60090.

Circle 207 on Inquiry Card

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CIRCLE 156 ON INQUIRY CARD



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The level of modulation uniformity in every Maxell floppy is vital to double density recording and readout. It means no peak shift, complete freedom from dropouts, total absence of particle orientation. Plus longer life, greater overall durability, and significantly less oxide build-up and head abrasion.

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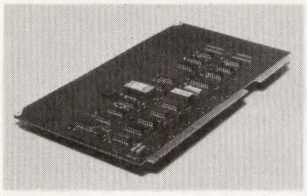
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PRODUCTS

FLOATING POINT PROCESSOR BOARD

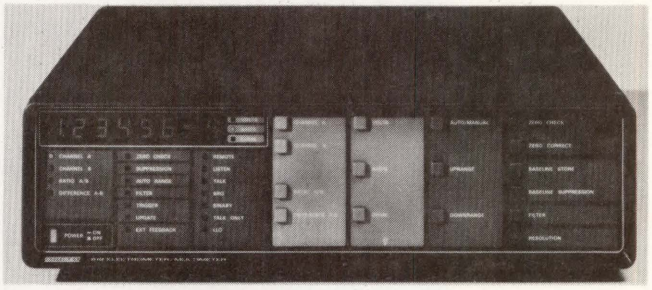


The single-board Am95/6012 arithmetic floating point processor unit is a high speed arithmetic processor enhancement for Multibus compatible systems. The processor adds, subtracts, multiplies, and divides in either 32-bit single-precision or 64-bit double-precision formats. Data format of the result conforms to the proposed IEEE floating point format. The processor is built around the stack oriented Am9512 floating point processing unit. Processing speed, based on a 2-MHz clock, ranges from 29 μs (58 clock periods) for a single-precision 32-bit add to 2280 μs (4560 clock periods) for a 64-bit double-precision divide. **Advanced Micro Devices, Inc,** 901 Thompson Pl, Sunnyvale, CA 94086. Circle 208 on Inquiry Card

TTL-COMPATIBLE 4ϕ CLOCK MODULE

The DIP series 4-phase clock module provides precise TTL level 4-phase, square wave outputs at frequencies from 200 kHz to 12 MHz. They are synchronized by single level inputs at the selected frequency. The modules will accept input with duty cycle from 25% high/75% low to 75% high/25% low with minimal effect on output duty cycle. Module input is a two fan-in Schottky TTL. All outputs are toggle-type Schottky TTL capable of driving 10 TTL Schottky loads per phase. Modules are packaged in 32-pin DIP housings molded of flame-proof diallyl phthalate per MIL-M-14, type SDG-F and are fully encapsulated in epoxy resin. **Engineered Components Co,** 3580 Sacramento Dr, San Luis Obispo, CA 93401.
Circle 209 on Inquiry Card

PROGRAMMABLE ELECTROMETER DIGITAL MULTIMETER



Dual-channel 619 is a partitioned system where each instrument is assigned a set of tasks with no duplication of elements. Electrometer sensitivity is <100 fA to 2 A with 10 fA lsd, <10 μV to 200 V with 10 TΩ input impedance and 1 μV lsd, and <0.1 Ω to 2 TΩ with 0.01Ω lsd. The unit provides 4½- or 5½-digit resolution with manual or automatic ranging. Function, range and all front panel controls except ratio and difference are programmable. Conversion times are 18 ms/conversion at 3½-digit precision and 35 ms/conversion at 4½-digit precision. The dual-channel format allows a single-channel unit to be fitted later with a second channel. **Keithley Instruments, Inc,** 28775 Aurora Rd, Cleveland, OH 44139.
Circle 210 on Inquiry Card

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Cambi-Cards® are available as either general purpose pre-drilled PC boards for socketing to your own design featuring distributed power and ground planes, or as hi-density boards to support dual in-line IC's in wire-wrappable sockets. Fill out the Bingo card for Catalog 121 and useful card info!

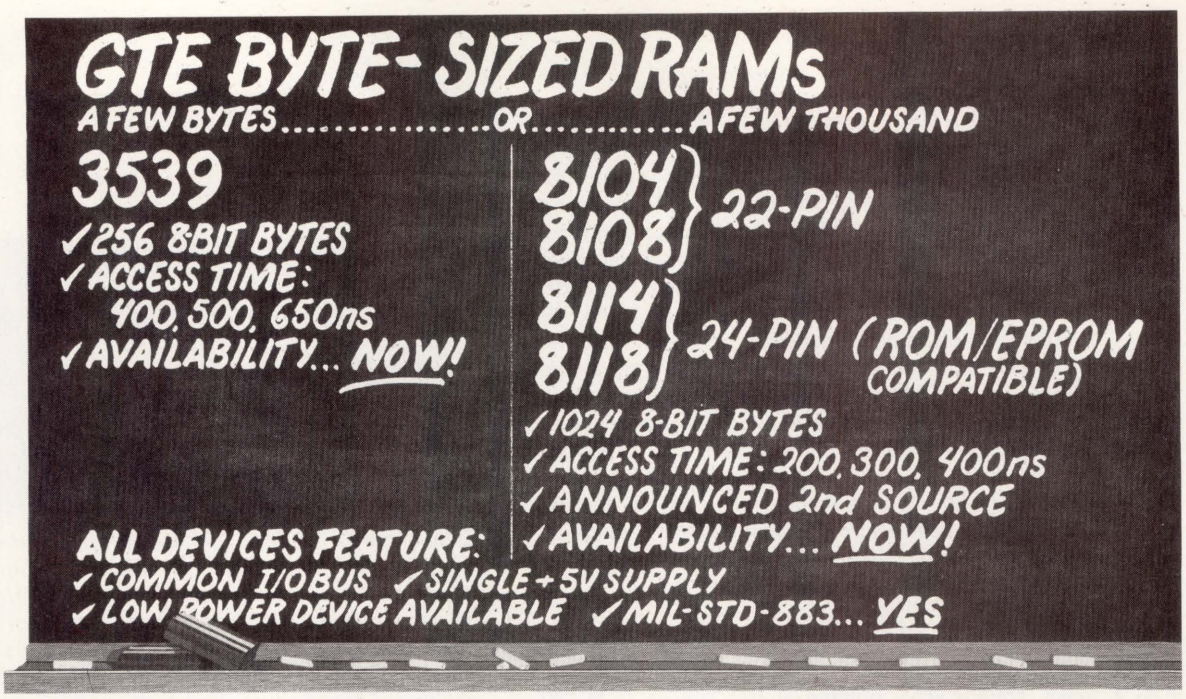


Cambridge Thermionic Corporation, 445 Concord Avenue, Cambridge, MA 02238,
Tel: (617) 491-5400,
Telex: 92-1480,
TWX: (710) 320-6399

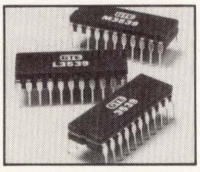
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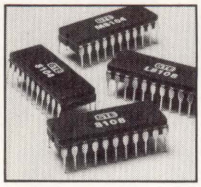


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If your system needs just a few bytes of memory, take a good hard look at our 3539. For small memory designs, it's ideal. It's organized as 256 8-bit bytes ...a 2048 bit Static RAM packaged in a standard 22-pin DIP. You have a choice of access times...and what's more, it's available in a low power configuration, or you can select a military version that meets MIL-STD-883 requirements. The time-proven, highly reliable 3539 is a natural upgrade for small memory applications using 2111's and 2112's...and you'll like the byte oriented I/O structure.



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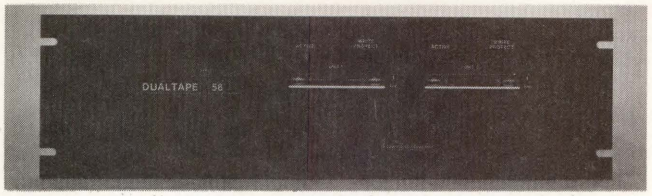
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(602) 968-4431
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CIRCLE 159 ON INQUIRY CARD

REMOVABLE MASS STORAGE UNIT



Capable of holding 256k bytes on each of 2 removable cassette tape cartridges, the Dualtape-58 provides 512k bytes of online random access storage. An intelligent controller allows a computer to randomly access any of the 1024 blocks of storage as though it were on disc. A high speed search mode gives an average access time of 9.3 s to any block. The unit is supported as a standard device under RSTS-E, RSX-11M, and RT-11 operating systems. RT-11 allows its use as a system device. Through an RS-232 or RS-423 asynchronous port, the unit interfaces to any computer at rates from 150 to 38.4k baud. **General Digital Corp, Inc,** 3322 S Memorial Pkwy, Huntsville, AL 35801.

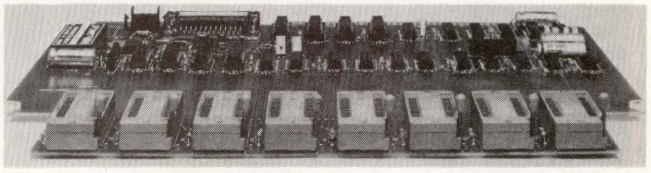
Circle 211 on Inquiry Card

INTEGRATED DRIVER WITH PIGTAILED FIBER OPTIC LED

LDT-256 combines a standard 75452B TTL driver chip with a pigtailed IRE-160F etched well LED packaged in a 16-pin DIP. The control circuit accepts standard TTL inputs and will drive either NRZ or RZ codes. NRZ data rates can go to 40 MHz and RZ codes to 20 MHz. The IC will drive up to 200 mA dc. The etched well emitter will couple over 500-μW core power into standard communication grade fiber comprised of 55-μm core, 125-μm cladding OD, and 0.2 numerical aperture. The LED offers 10-ns typical rise and fall times and a peak emission wavelength of 820 nm. Choice of pigtailed fiber and alternate peak emission wavelength is available. **Laser Diode Laboratories, Inc,** 1130 Somerset St, New Brunswick, NJ 08901.

Circle 212 on Inquiry Card

EPROM PROGRAMMER



Available in models for Intel 2716, 2732, and 2732A EPROMs, the ZX-908 will program up to 16k bytes of EPROM storage in one operation. Eight zero-insertion force sockets allow quick P/ROM insertion and withdrawal. The unit can operate within the Multibus chassis with simple software drivers. Optional cabinet with power supply and cables allow it to be used in a standalone operation cabled to an MDS development system. In the Multibus mode, read data and write address are programmable in 100-ns steps from 100 ns to 1.5 ms; program data takes 100 ns to 1.5 ms for host to write data. Voltage and pulse timing to the EPROMs is guaranteed to be within published specs. **Zendex Corp,** 6398 Dougherty Rd, Dublin, CA 94566.

Circle 213 on Inquiry Card

HERMETIC DIGITAL



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- Hermetic, metal 14-pin DIP (.870"L × .498"W × .250"D)
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6800 6809

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Available off-the-shelf support for the 6800 family of processors includes the FLEX™ disk operating system, editors, macro-assemblers, sort/merge, diagnostics, utilities, text processors, and more. PASCAL, "C", and a multi-user/multi-tasking operating system are being developed.

All our software is available for single-end use or OEM licensing. We also develop custom OEM software packages.

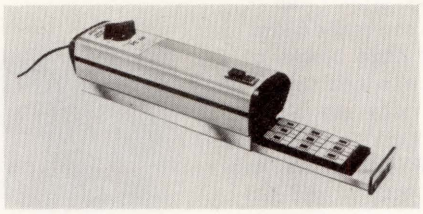
If you are looking for the best 6800/6809 systems software available, call Technical Systems Consultants, Inc. at (317) 463-2502, or Telex 276143.

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CIRCLE 162 ON INQUIRY CARD

PRODUCTS

Series OPL-700 2-leaded bicolor LED lamps in T-1 package size for stop-go and on-off indication use III-IV GaP technology to provide combinations of red, green, international orange, and yellow. Low current, high efficiency devices feature typ luminous intensities of 2 mcd with forward voltage of 2.5 V at 20 mA, and half-intensity viewing angles of 80°. Lens has 0.12 (3.04-mm) diameter and 0.20″ (5.08-mm) height. **OPCOA,** 330 Talmadge Rd, Edison, NJ 08817.
Circle 257 on Inquiry Card



Up to 9 EPROMS are erased at a time with the erase lamp, which uses 2 UV tubes to increase uniform erase area and improve erase time. A conductive-foam pad protects EPROMs from being erased by static charges, and holds each device stationary at the correct distance from the tubes. Designed for engineering and low volume manufacturing uses, PE-24T erases most EPROMs in 30 min, fully loaded. The lamp has an extruded aluminum housing and easi-load tray. **ADCO Electronics,** 2182 DuPont, Ste 222, Irvine, CA 92715.
Circle 255 on Inquiry Card

HPIN series operates over a wavelength range covering the visible spectrum from 400 to 1100 nm. At 900 nm, responsivity is 0.63 and quantum efficiency is 87%. Ion-implanted devices are low temperature processed for high quantum efficiency and include silicon nitride passivation for low leakage and stability. Five parts (with package type and surface area) are: 002 (TO-18, 0.0025 mm²), 040 (TO-18, 0.852 mm²), 100 (TO-5, 5.07 mm²), 200 (TO-8, 20.3 mm²), and 444 (30-mm, 100 mm²). **Hughes Image and Display Products,** 6155 El Camino Real, Carlsbad, CA 92008.
Circle 258 on Inquiry Card

Model 4830 provides optical isolation for single instruments or a collection of up to 14 instruments being operated from the IEEE-488 bus. The accessory also serves as an IEEE bus expander when plugged into an existing IEEE bus system; expansion capability allows up to 14 additional instruments on the same IEEE controller. Selection of talk addresses prevents interaction of handshake lines between the primary and isolated IEEE buses. **ICS Electronics Corp,** 1450 Koll Cir, Ste 105, San Jose, CA 95112.
Circle 256 on Inquiry Card

PTC BT-2 is a DEC LSI-11 based standalone voice response system that communicates messages and alarms in natural human sentences or phrases. The RS-232-C compatible system uses telephone quality male or female speech. Voice response is not computer synthesized. The unit comes standard with 8 channels of speech output and approx 30 words. Max configuration is 64 input and 64 output channels, and 256 words. **Perception Technology Corp,** 95 Cross St, Winchester, MA 01890.
Circle 259 on Inquiry Card

Just what the doctor ordered for mass termination.

See page 217

Disk-to-disk backup in a very compact disk drive.



The D100 family of compact disk drives is specially designed for OEMs and system builders. Model D140 includes a 10MB fixed platter in addition to the 10MB removable cartridge also used with the D120. In addition to disk-to-disk backup, the D100 family offers a surprising list of advantages.

High Capacity Storage: The D160, which uses a sealed module (non-removable) that includes thin-film integrated heads and carriage, offers up to 120MB of preformatted storage.

Small Size: Occupying approximately one-third the volume of conventional drives, Models D120 and D160 measure 5.6″ x 12.2″ x 21.8″. Model D140 is slightly taller at 6.7″.

Innovative Cartridge: Both D120 and D140 models use a flat, thin (11″ square by .9″) self-ventilated cartridge weighing only 2.8 pounds.

Common Interface: The transfer rate is 920 kilobytes/sec. for all units. The same controller handles D120, D140, D160, or any combination of the three models. One or more D160s in conjunction with a D120 provide a fixed data base with a high-throughput-10MB load-dump yielding twice the operating flexibility at half the size of conventional single-spindle drives.

Accuracy: Data-imbedded servo-tracking techniques assure accurate head positioning and full cartridge interchangeability.

Low Power Consumption: From 100 to 130 watts depending on the model.

Reliability: Simplified mechanisms rule out the need for preventive maintenance. The spindle-mounted dc motor is brushless. There are no belts or pulleys, no blower, no transducer, no thermal compensation device. And no head alignment is required. MTBF is 5000 hours for models D120 and D140 , 8000 hours for the D160.

Cii Honeywell Bull

For more information, send coupon to:
OEM Marketing, Bull Corporation of America, 200 Smith Street (MS 430) Waltham, Massachusetts 02154 or call (617) 895-6020. (In Europe, write OEM Sales Department, rue Jean Jaures, 78340 Les Clayes Sous-Bois, France, or call 055 8000 in Paris.)

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Senior Engineer

—to specify and direct modification of programmable terminal and terminal peripherals, and terminal modifications. Requires at least 4 years experience including micro-processor peripheral interface development, digital design and diagnostic software development, BSEE.

Data Communication Systems Engineers

Several individuals sought with ten years experience in both hardware and software associated with communication systems, including multiplexers, transmission media, radio, fibre optics, etc.

C^3 Systems Engineers

A number of openings call for BSEE's (MS desirable) with at least ten years current professional experience in analysis, specification, design, testing, and evaluation of state-of-the-art communications equipment.

Specific areas of background most highly valued include: (a) Experience in communications network performance analysis; (b) Experience with secure communications techniques including current encryption and spread-spectrum techniques; (c) Experience in acquisition and integration of military R&D systems and equipment into the Defense Communication System; (d) Experience in test and evaluation of military communications equipment.

Assignments will include performance of theoretical analyses and independent designs of present and planned military command and control systems under varying operational and environmental conditions... providing test planning, monitoring and independent analysis of test results for developing communications equipment and systems... and providing technical consultation to a variety of government engineering agencies.

Senior Digital Communications Engineer

—to be involved in preparation of test and installation plans for digital communications equipment on site. Will interface with international telephone companies to evaluate local site facilities, assess capability and determine installation schedule. Requires at least 4 years experience in such subjects as communications network configuration, selection of modems and test equipment, installation. Should be familiar with Bell and CCITT specifications. BSEE.

Equipment Configuration Engineer

—will prepare command center and training institute equipment configuration, integrate procured equipment into final CC configuration. Requires at least 2 years experience including documentation and A/V systems in support of command center applications. Communications and ADP experience desirable. BS in EE or equivalent.

Command Center Design Engineer

—to participate in hardware design, equipment and system implementation, testing, documentation, etc. Requires at least 2 years experience related to military command center, audiovisual, television studio operation and maintenance. BSEE or equivalent.

For a prompt response, mail your resume in full confidence to The Director of Professional Staffing, MC/218-FD.

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CIRCLE 164 ON INQUIRY CARD

With IDT Color Terminals, the Choice is Yours:



A Choice of Models

From the IDT color terminal family you can choose the powerfully efficient IDT-900, or the extra-intelligent IDT-1000. Either choice gives you an easy-to-program, easy-to-operate unit — designed and built for reliable performance in rugged *industrial* applications.

A Choice of Capabilities

The IDT-900 features downline-loadable character graphics, with an unlimited number of special symbols for programming into vertically-scrollable, bright and sharp color displays. Add another video generator to the package that creates an independent video overlay, and you have the IDT-1000. This second vertically- and *horizontally*-scrollable memory plane allows for the creation of true vector graphics, thanks to its 512 x 256 *individually* addressable dots.

A Choice of Packages

Both the IDT-900 and the IDT-1000 — like IDT's color monitors — are available in rack-mounted and cabinet-enclosed configurations.

The options and abilities of these terminals go on. Give us a call for more information.

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Now there's a 20 MHz gate array that outperforms TTL and low power Schottky!

Introducing high-speed CML Monochips.™



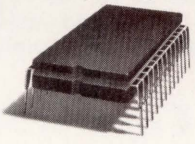
In today's competitive design race, Interdesign gives you the edge you need to win. CML Monochips are fast enough, large enough, and flexible enough to satisfy a variety of functions in computer, telecommunications, and instrumentation designs.

With toggle rates to 20 MHz and propagation delays as low as 3 nsec, CML Monochips give you the speed you need with a minimum power requirement.

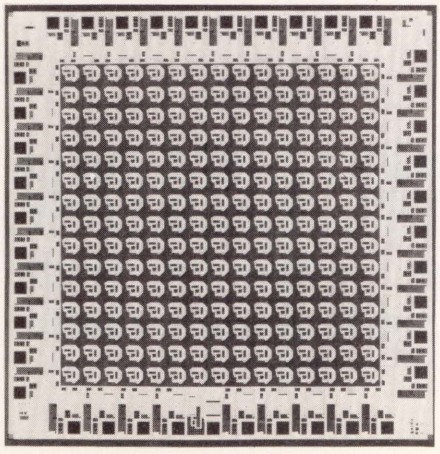
Monochip CML IC's are easy to design because we've simplified the chip's architecture. Our $25 Design Manual gives you everything you need to lay out your own custom 450- or 880-gate array. Working from your layout, we'll deliver 20 prototypes in 8 to 10 weeks for your evaluation. Once you've approved them, we'll make 1,000 to 500,000 parts for you.

CML Monochips give you all the advantages of custom IC's without the cost or lead time of full custom development. For more information, call or write us today. Interdesign Inc., 1255 Reamwood Avenue, Sunnyvale, CA 94086. Telephone: (408) 734-8666. TWX: 910 339 9374.

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Typical Applications

Disk and CRT Controllers
Dynamic and Static Memory Controllers
Keyboard Scanners
Memory Interface Logic
Control Logic—CPU Boards
ALU Accumulators
D/A—A/D Controllers

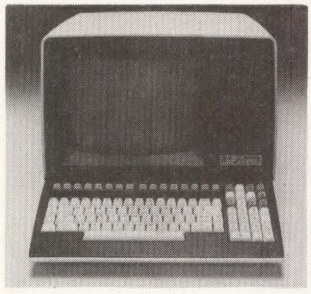
Interdesign is a Ferranti Company

CIRCLE 166 ON INQUIRY CARD

PRODUCTS

INTELLIGENT CRT TERMINAL

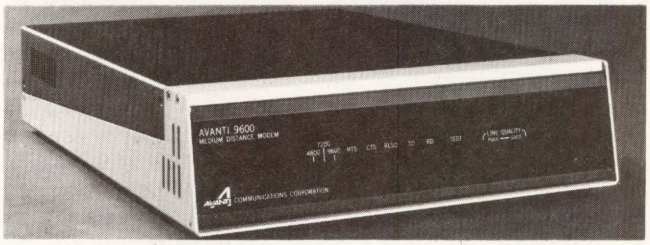
Housed in a self-contained desktop enclosure, ZMS-40 features an Intel 8085A microprocessor chip with up to 16k bytes of RAM, a 12″ (30-cm) diagonal nonglare video display, keyboard, an asynchronous telecommunications port, and an optional RS-232-C printer interface. Word processing programs can be downloaded into the terminal and programs can be executed in firmware. High resolution display offers 24 lines of 80 char each plus a 25th operator error/status information line. Keyboard features a 96-char u/lc ASCII set, 14-key numeric keypad, 12 function keys, and 16 programmable function keys. **Zentec Corp,** 2400 Walsh Ave, Santa Clara, CA 95050. Circle 214 on Inquiry Card



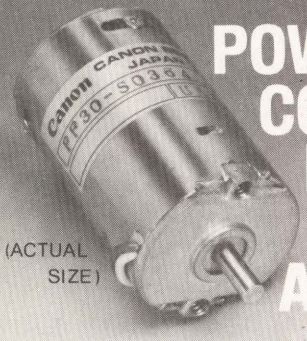
ADD-IN MEMORIES FOR LSI- AND PDP-11 COMPUTERS

Hardware and software compatible with LSI-11, LSI-11/02, PDP-11/03, and PDP-11/23, models 11/16 and 11/32 memories plug into any option slot. LSI control devices and industry standard 16-pin MOS dynamic RAMs provide high density and long life. Write access time for the memories is 170 ns. Read access time is 375 ns. Cycle time is SYNC + 20 ns. Features include switch selectable page addressing beginning on any 4k boundary, card addressing for up to 4 cards, and I/O page addressing selectable to 2k or 4k words. MTBF exceeds 10k hours. The boards require 5 Vdc at 1.1A, and 12 Vdc at 0.41 A. **Lazor Systems Inc,** 1050 E Duane Ave, Suite F, Sunnyvale, CA 94086.
Circle 215 on Inquiry Card

9600-BIT/s LOCAL/MEDIUM DISTANCE MODEM



Microprocessor based model 9600 modem operates synchronously at 9600 bits/s over 3002 voice grade telephone lines at distances up to 100 mi (160 km). Features include single-board design with post regulated power, fallback rates of 7200 and 4800 bits/s, CCITT V.29 compatibility, local (analog and digital) and remote digital loopback, a built-in eye pattern generator, and an Intelligent Equalizer that eliminates need for manual adjustment. Hinge-down front panel and slide-out board insure easy access to controls. The modem is available as desktop unit that can also be rackmounted, as well as rackmounted modules. It is also available as a single-card to OEMs. **Avanti Communications Corp,** Newport, RI 02840.
Circle 216 on Inquiry Card



(ACTUAL SIZE)

POWERFUL COMPACT DC MOTOR WITH AC TACH

Available in OEM quantities, the FF 30 DC motor with integral 8 Hz AC tachometer provides high efficiency, long life and low electrical interference and mechanical noise. Available with AMP 110 terminals. 30mm dia., 48mm long.

- *Varistor ring and high quality brush material for low electrical noise*
- *2 V RMS AC tach output controls speed*
- *Maximum efficiency more than 60% at 12V*
- *7 slot core for smooth operation*

SPECIFICATIONS			
Rated Voltage:	12V	No Load Current:	115 mA
Rated Load:	75g-cm	Starting Torque:	280 g-cm
Rated Speed:	4700 ± 500 rpm	Stalled Current:	1800 mA
No Load Speed:	6450 rpm	Motor Regulation:	23 rpm/g-cm
		Rotation:	CCW

For complete technical information:
Canon

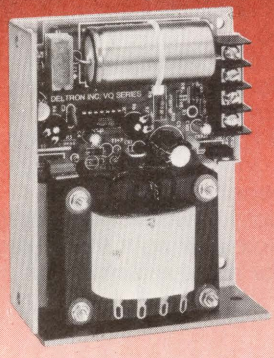
Canon, U.S.A., Inc.
Electronic Components Div.
10 Nevada Drive,
Lake Success, N.Y. 11042
516/488-6700 Telex: 96-1333
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Model VQ5-3C

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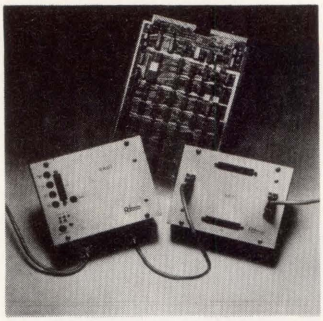
Deltron inc.

Wissahickon Avenue • North Wales, PA 19454
Tel: 215/699-9261 Twx: 510/661-8061

AC 32

CIRCLE 168 ON INQUIRY CARD

REMOTE DATA ACQUISITION SYSTEM

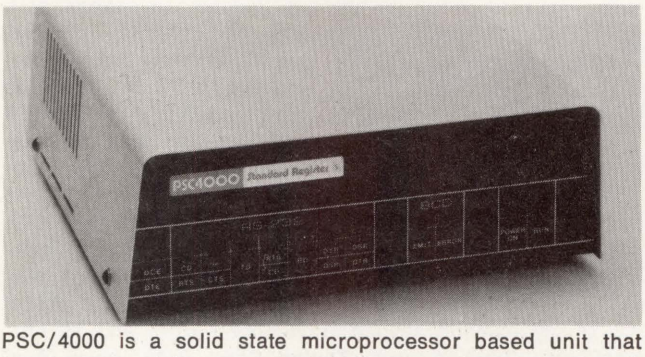


RIM system offers high performance, reliable, yet economical solutions to system requirements when analog or digital inputs or outputs, pulse and control outputs, or sensor inputs are needed. Depending on distance and speed requirements, modules may be accessed up to 500′ (152 m) at a transfer rate of 4 MHz. At a distance of 1 km, operation at 16 kHz is possible. Up to 16 modules may be daisy chained on a single line. System modules include ADCs, multiplexers, line controllers, a resistance temperature converter, and thermocouple converters. All power, control, and data signals are supplied by a single cable at distances to 250′ (76 m). **Precision Data Systems,** 2030 N Forbes, Tucson, AZ 85705.
Circle 217 on Inquiry Card

GENERAL PURPOSE FIBER OPTIC RECEIVER AMPLIFIER

Designed for fiber optic data communications between computers and peripherals over short distance T1, T2, and T3 telephone links, the LH0082 permits selection of internal feedback resistors to set both gain and bandwidth. The 2-GHz gain-bandwidth of the preamplifier on the device permits fast response even with large capacitance photodiodes. Compatible with TTL, DTL, and CMOS logic levels, the amplifier operates from a single supply over a range from 4.5 to 10 V. Using typical pin photodiodes, data rates of 45M bits/s at 22 μW, 1M bits/s at 30 nW, and 6M bits/s at 330 nW can be achieved with 10^{-9} BER sensitivity. **National Semiconductor Corp,** 2900 Semiconductor Dr, Santa Clara, CA 95051.

PARALLEL-SERIAL CONVERTER



PSC/4000 is a solid state microprocessor based unit that interfaces a variety of quantitative measuring devices such as scales, counters, shaders, wand readers, or lineal feet indicators with mini and microcomputers, CRTs, teletypewriters, and serial printers. The integral microprocessor is an Intel 8085 with up to 8k of EPROM and 256 bytes of RAM. The converter features buffered I/O and has 13 input lines, 16 I/O lines, and 3 interrupt lines for its parallel programming. Programmable elements in the serial interface are baud rate, parity, character length, and number of stop bits. RS-232, 20-mA, or 2-wire direct interfaces are provided. **The Standard Register Co,** PO Box 1167, Dayton, OH 45401.
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With Custom Systems' controllers, it's plug in and go! Installation is simple and trouble free. Each board is factory configured to your particular needs and shipped complete with installation instructions, documentation package, and peripheral cable.

Our complete line of multiplexers, memory control boards, I/O controllers, and accessories is specially tailored for the Data General System user.

Speedy delivery (usually 2 weeks) and quick, easy installation can help relax your tight schedules. Call or write Custom Systems for more information.

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17+ MEGABYTE DISK BACKUP

DEI COMPATIBLE CARTRIDGE TAPE DRIVE

The Model 400 MAXIDRIVE™ packs 17.2 megabytes on a single data cartridge and is loaded with advanced features. Unique, hard mounted motor. Rugged transport mechanism. Excellent power dissipation. High, 6400 bpi density. Fast, 192,000 bps transfer rate. Four-track, read-after-write dual-gap head, with selective erase. Solid state BOT/EOT detection. Plug-in electronics. Plus more.

Contact us today for complete details —

Qantex

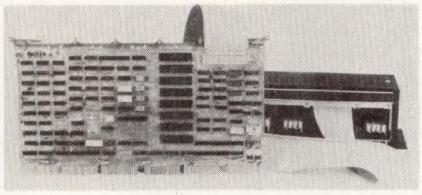
Division of
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60 Plant Avenue, Hauppauge, NY 11787
(516) 582-6060 TWX 510-227-9660

See us at NCC-Booth No. 1647

CIRCLE 170 ON INQUIRY CARD

PRODUCTS

PDP-11 COMPATIBLE ASYNCHRONOUS MULTIPLEXER



Series 2033 features automatic selection of RS-232-C or current loop operation on an individual channel basis for each of 8 or 16 channels. Split transmit/receive baud rates are switch selectable for each channel. Unit combines RS-423 high speed data drivers with 19.2k-baud capability to permit high current long distance transmission. 16 data rates from 50 to 19.2k baud are available. Unit is supplied in hex board configuration. **Gen Comp Inc,** 6 Algonquin Rd, Canton, MA 02021.
Circle 223 on Inquiry Card



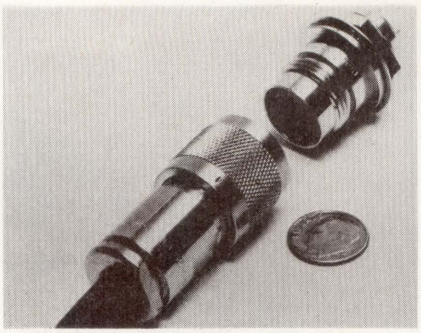
It's axiomatic why our low cost electrosensitive printers and plotters have outsold all the rest

Our electrosensitive EX801 printers and EX820 plotters are mighty good looking. But that's just the frosting on the cake. They're also tough little work horses, printing day in, year out in the severest of environments. No ribbons or print heads to change. When the buzzer rings, just change paper. Available as a complete printer in stand-alone cabinet, or in stripped down modules for inclusion in your own chassis. Choose the interface you need: RS232C/20Ma serial, Centronics parallel, high speed serial, Apple, Pet, TRS-80, IEEE 488- and more. Worldwide service in 18 countries. We've delivered over 12,000 - twice as many as all others combined.

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TWINAXIAL EDP CONNECTORS



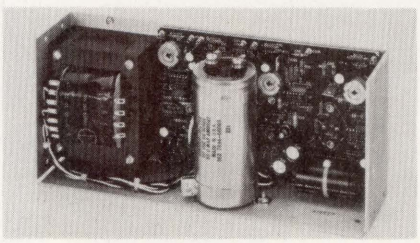
Facilitating interconnection of mainframe computer systems with CRT displays, printers, and other peripherals, Twinax series includes a plug which terminates Belden YR15662, Brand Rex T9756A, or equivalent twinaxial cable; a receptacle; and an adapter for inline cable splices. Matched pin and slot keyway design maintains conductor polarization. Connectors operate through 500 MHz, with nom impedance of 90 Ω. **Amphenol North America Div, Bunker Ramo Corp,** 2122 York Rd, Oak Brook, IL 60521.
Circle 224 on Inquiry Card

RECTANGULAR LEDS

Measuring 0.1″ W x 0.2″ H (0.25 x 0.5 cm) rectangular LED lamps in red, green, and yellow may be stacked in line, 10/in (4/cm) to create an illuminated bar graph effect. In operation, the lamps emit a narrow rectangular wedge of light. Luminous intensity with 20-mA current is typ 2.0 mcd; max power dissipation at 25 °C is 200 mW for red lamps and 160 mW for green and yellow. **Litronix, Inc,** 19000 Homestead Rd, Cupertino, CA 95014.
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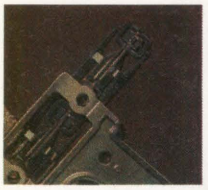
MULTIPLE OUTPUT DC POWER SUPPLY

Designed to power Winchester technology fixed disc memory systems, model CP384 can power drives including Shugart SA1000 and SA4000 series, Century Marksman, and Micropolis Microdisk 1200 series. The supply also provides power to operate required controller circuitry. Dc outputs are 5 V at 9 A, 24 V at 4.5 A peak, and −12 V at 0.8 A. Complete protection against short circuits and overloads is also provided. **Power-One Inc,** Power One Dr, Camarillo, CA 93010.



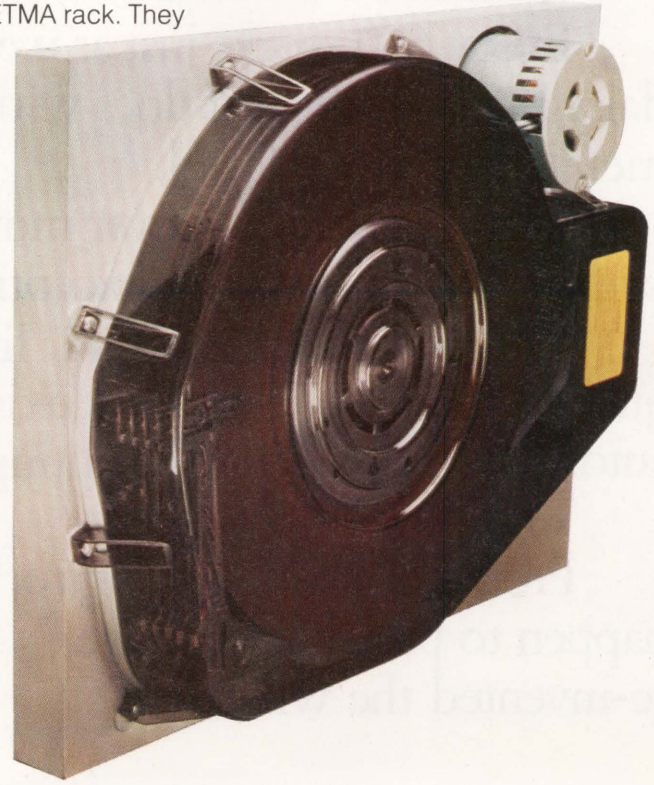
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Introducing the Shugart SA4100. 58 MBytes for under $3,000.



The affordable solution. The SA4100 is your mass storage solution for all types of multi-function and shared logic systems. Now you can offer your customers a highly cost-effective system with 58 MBytes (or more if you daisy chain) of compact, reliable Winchester data storage. Now you can replace high cost per function storage modules and cartridge drives. And now you can easily upgrade your floppy or SA4000 fixed disk system. Shugart's SA4100. The right drive. The right time. The right price.

Reliable performance with no preventive maintenance. Like our SA4000 fixed disk series, the new SA4100 has Winchester head and media technology for high data reliability. And we've made system integration and upgrading easier, too. For example, SA4000 and SA4100 drives are the same compact size, using only 5.25-inches of panel space and mounting in a 19-inch RETMA rack. They even have the same floppy-like interface. And you can share a power supply with our 8-inch floppy drives. Add to this our proprietary Fasflex II™ band actuator for fast, sure data access with no field adjustment, a sealed media chamber for super data integrity, and a single PCB with all drive electronics for added serviceability and reliability. To help you get started, try our new SA1400 intelligent controller with ECC, resident microdiagnostics, sector interleaving, and buffering. The SA4100. Great features, no preventive maintenance, and super reliability.



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Headstrong about fixed disk value

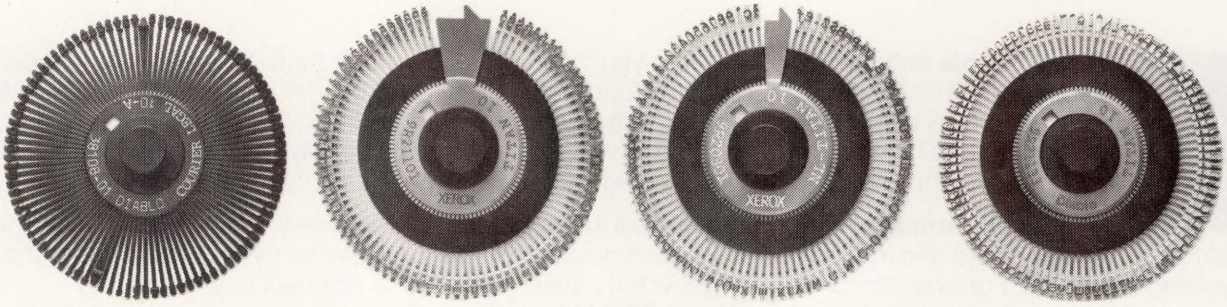
See us at NCC Booth #2462

CIRCLE 172 ON INQUIRY CARD

Diablo introduces the first printer that runs on four wheels.

The Diablo 630 printer is the most versatile printer you can get.

It's the only one that gives you a choice of 4 different interchangeable print wheels and over 100 different type styles.



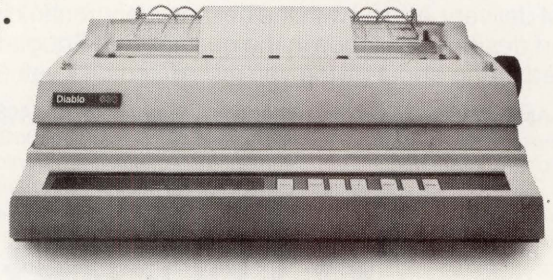
Every 630 works just as well with a 96-character plastic daisy print wheel as it does with an 88, 92, or 96-character metal daisy print wheel.

The 630 also has fewer moving parts than competitive printers, which makes it exceptionally reliable.

This new addition to our line offers unsurpassed print quality. Compatibility with existing Diablo supplies. And automatic bi-directional printing.

The Diablo 630 printer.

Probably the best thing to happen to printing since we re-invented the wheel.



Diablo Systems

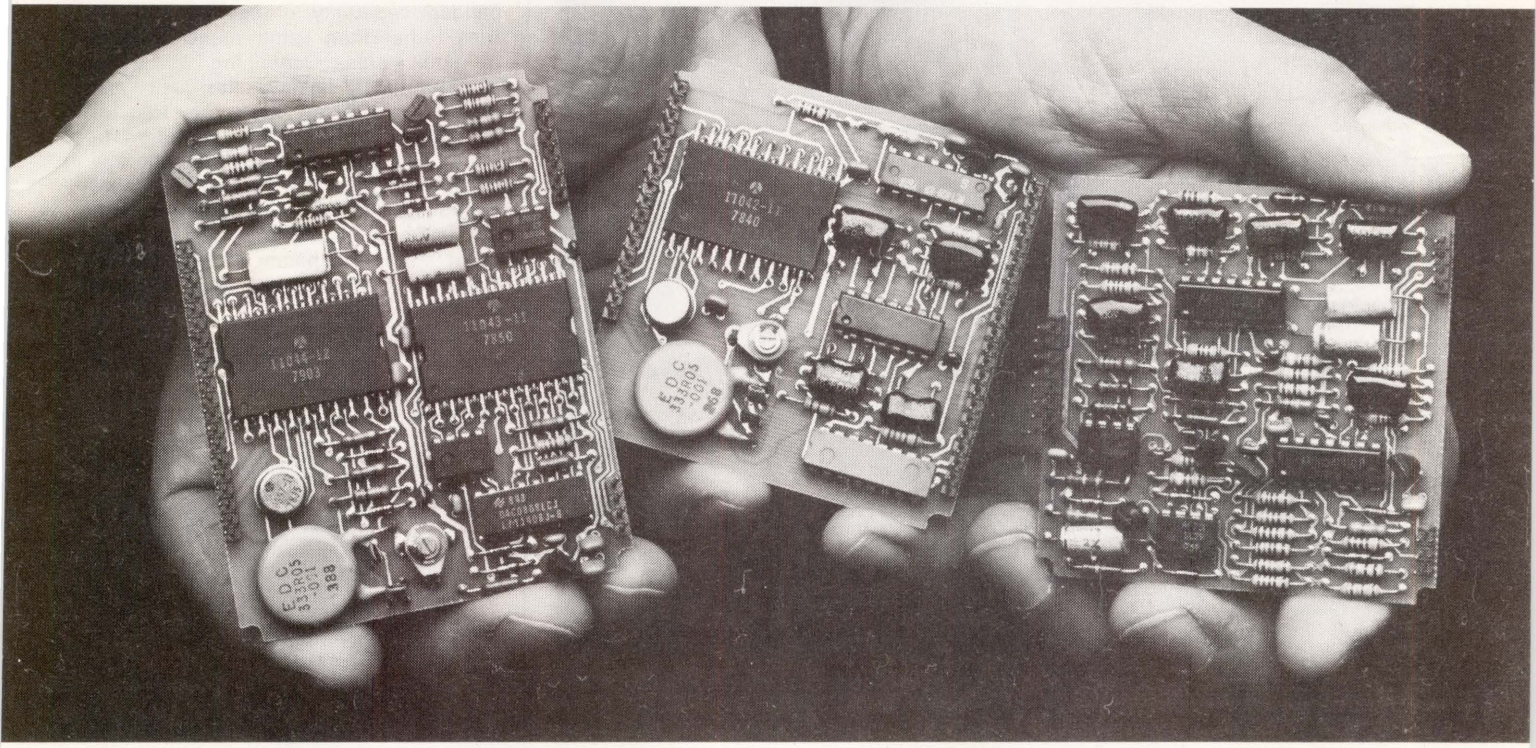
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CIRCLE 173 ON INQUIRY CARD

R24. The first 2400 bps modular modem.



Rockwell's compact MOS-LSI modem gives new physical design freedom.

Micro Power

Rockwell's R24 Modem is the most compact 2400 bps MOS-LSI modem available today. Its small size and modularity give designers a whole new form factor flexibility. Requiring only 25 square inches of system area, the R24 is ideal for terminals and communications equipment.

The R24 provides functional flexibility also. Of its 3 modules, one is the transmitter, two the receiver. Terminal designers can offer transmit-only or receive-only options. And, the R24 is Bell 201 B/C and CCITT V.26 and V.26 bis compatible.

With its major functions in LSI circuits, the R24 is solid-state reliable and economical. It can be configured for operation on either leased lines or the general switched network. And, each low-profile module can be plugged into standard connectors or wave soldered onto system PC boards.

A new generation of modems from the company that's delivered more high-speed modems than anyone in the world. That's Rockwell Micropower!

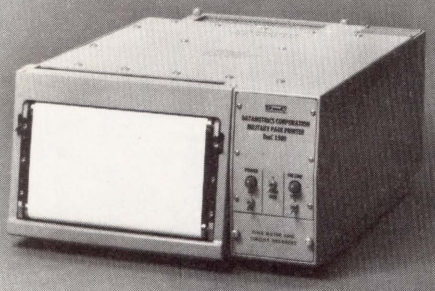
For more information, contact Modem Marketing, Electronic Devices Division, Rockwell International, P.O. Box 3669, RC 55, Anaheim, California 92803. (714) 632-5535.

Rockwell International

...where science gets down to business

CIRCLE 174 ON INQUIRY CARD

THE UNTOUCHABLES



The DmC 1500 operates asynchronously at any speed up to 1200 lines per minute, 80 characters per line, using standard ASCII 64-character subset or any 64-character code. Qualified, documented, and nomenclatured to all applicable Military specifications, the 1500 is compact, light-weight and simple to operate. Solid state electronics and modular plug-in circuit boards provide a 30 minute MTTR and an MTBF of more than 20,000 hours.

The DmC 1500. The only printer you may ever need.

DmC 1500

DATAMETRICS CORPORATION PRESENTS THE DmC 1500 MEDIUM-SPEED, NON-IMPACT MILITARY PAGE PRINTER.

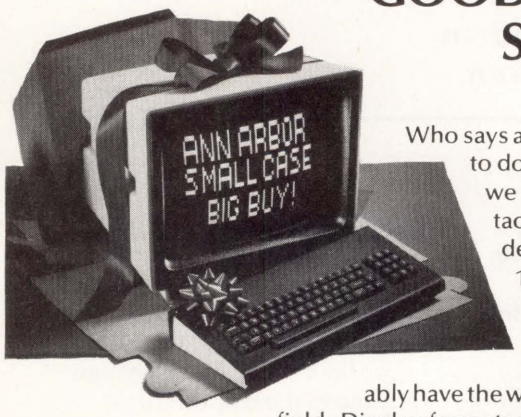
DmC

Datametrics Corporation

7630 Gloria Avenue, Van Nuys, California 91406 • (213) 989-3840

CIRCLE 175 ON INQUIRY CARD

GOOD CRT'S COME IN SMALL PACKAGES



Who says a CRT terminal has to be big and bulky to do a good job? At Ann Arbor Terminals, we offer a full 15-inch screen *and* detached keyboard as standard on all our desktop terminals. And the case is only 14" wide by 15" high by 13.6" deep. We're known throughout the industry for our high quality and reliability. On top of this, we probably have the widest range of available options in the field. Display formats from 256 to 4800 characters. Foreign language character sets. Special command sets. Custom keyboards. Editing, protected fields and block transmit.

And if your application doesn't lend itself to a desktop terminal, we offer display controllers (especially good in industrial environments) for use with free-standing monitors. Or buy our terminal without the case and mount it in your own console.

So when the CRT is the focal point of your system, why settle for a large case and small screen? You can have excellent readability without taking up a lot of room. And get the features you need. Call us for more information at Ann Arbor Terminals, Inc., 6175 Jackson Road, Ann Arbor, Michigan 48103.
Tel: (313)663-8000. TWX: 810-223-6033.

ANN ARBOR TERMINALS INC

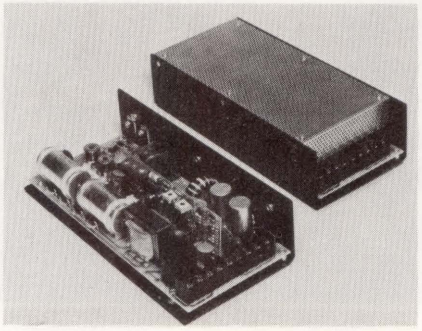
CIRCLE 176 ON INQUIRY CARD

PRODUCTS

ALPHANUMERIC DATA ENTRY TERMINAL

The 101 Alpha-1™ gives users the expanded capability of spelling out entries rather than using numeric codes or equivalents. Containing a 16-char alphanumeric display, the unit also features a 39-key keyboard that allows up to 97% of the entries to be made without the use of a shift key. Data stored in the device are telecommunicated to mainframe computers; memory capacity is 32k and program storage capacity is 12k. **Norand Corp,** 550 Second St, SE, Cedar Rapids, IA 52401.
Circle 227 on Inquiry Card

SWITCH MODE POWER SUPPLIES



Efficiency of over 70% characterizes the EPS75 series that is available in output voltages ranging from 5 V at 15 A to 24 V at 3 A in either open or enclosed frame versions. The 75-W supply is equipped with a std dual-input range of 90 to 132/180 to 250 Vac; it utilizes pulse width modulation, with high density >1 W/in^3 (16/cm^3). Low noise level is 50 mV pk-pk max as measured with a 300-MHz scope. **Elpac Power Systems,** 3131 S Standard Ave, Santa Ana, CA 92705.
Circle 228 on Inquiry Card

MIL SPEC SHIPBOARD TAPE RECORDER

Navy procured shipboard magnetic tape recorder for anti-submarine warfare (ASW) operations conforms to acoustic data recording and reproduction requirements on the LAMPS Mk III Program. Designed to MIL-E-16400 and MIL-STD-1610 requirements, AN/USH-32(V) uses 14" (36-cm) reels of 1" (3-cm) wide tape to record and reproduce up to 28 channels of wideband direct and wideband group II fm data. Unit meets specs for fm noise floor of −80 dB and spectral sidebands of −45 dB. **Bell & Howell Datatape Div,** 300 Sierra Madre Villa, Pasadena, CA 91109.
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No typing skills required

It's easier and more accurate to enter alphanumeric data with a BIT PAD than a keyboard. Now anyone can. . .

- Enter whole lines of characters with a single stroke.
- Enter data directly to business forms by simply checking a box.
- Enter variable alphanumeric data from a menu keyboard.

Take a printed form—price list, order entry, loan or insurance application, laboratory request—lay it on the BIT PAD tablet and touch the pertinent items with the pen. The information is entered directly into your data processing system.

Plus, the BIT PAD does even more.

Try to describe a fluctuating business trend to your computer through a keyboard. With BIT PAD you simply trace the trend with the pen. Special keyboard menus can be created by the user to enter high level languages, foreign languages or special symbols.

Before you order any kind of data entry equipment, ask Summagraphics to give you the full story on the BIT PAD ONE.

Summagraphics Corporation, 35 Brentwood Avenue, Fairfield, Connecticut 06430; or call Marketing Department, Peripheral Products (203) 384-1344.

Summagraphics® corporation

The BIT PAD™ alternative to keyboard data entry



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THE WINCHESTER BACKSTOP

56 Megabyte Disc Backup

Mag Tape Peripheral
for your non-removable disc
computer system

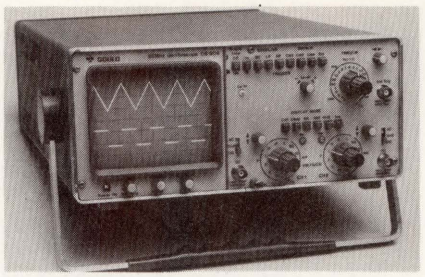


- Now something between reel-to-reel tape drives and floppy disc units
- 600 ft. 9-track 1/2" removable tape package
- Automatic Load/Unload
- Lowest cost per megabyte for disc backup applications

INTERDYNE
"Booth No. 1721 at NCC"

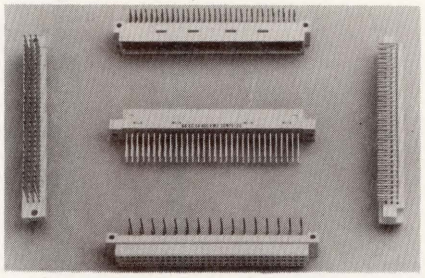
14761 Califa St., Van Nuys, CA • (213) 787-6800

DUAL-TRACE 25-MHz PORTABLE OSCILLOSCOPE



Housed in a rugged metal enclosure 5.25 x 12 x 16.25″ (13.34 x 30 x 41.28 cm), the OS1200 features a 5″ (13-cm) rectangular CRT. Specs are a 14-ns risetime, 6-kV accelerating potential for increased definition and brightness, and basic timebase speeds from 200 ns/cm to 1 s/cm with vernier control over a range of 2.5:1. Dual input channels have a max sensitivity of 2 mV/cm over the full 25-MHz bandwidth. **Gould Inc, Instruments Div,** 3631 Perkins Ave, Cleveland, OH 44114.
Circle 230 on Inquiry Card

EUROPEAN SPEC CONNECTORS



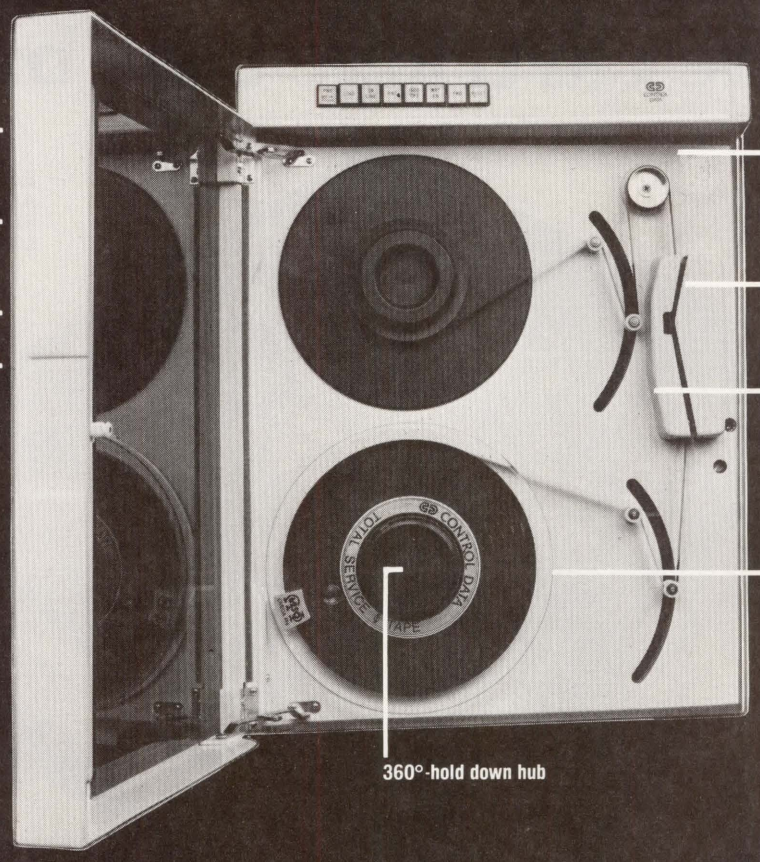
Series 68 meet requirements of CEI 130-14 and DIN 41612. Features include 3 rows of contacts, each having 32 contacts. Contact pitch is 0.100 x 0.100″ (0.254 x 0.254 cm). 2-piece device is available with male or female contacts in the plug and/or receptacle. All contacts are protected by means of plastic shroud or contact cavity. Units are suitable for printed circuit board, back panel, and rack and panel applications. **Socapex,** 6660 Variel Ave, Canoga Park, CA 91303.
Circle 231 on Inquiry Card

CONDUCTIVE PLASTIC TRIMMING POTENTIOMETERS

Subminiature trimming potentiometers featuring conductive plastic resistance elements have ⅓- and ½-W ratings. Both horizontal and vertical PC board mounting configurations are extremely resistant to flux and flux solvents. Resistance ranges are from 200 to 5M Ω. Standard resistance tolerance is ±20%. Knurled, circular knobs are offered in 10 colors, with special configurations also available. **Murata Corp of America,** 1148 Franklin Rd, SE, Marietta, GA 30067.
Circle 232 on Inquiry Card

CIRCLE 179 ON INQUIRY CARD

Innovations are what make Control Data's new tape drive so exceptionally reliable.





Now with the introduction of our new 9214X tension arm tape transport, OEM's can incorporate exceptionally reliable tape capabilities into their design. And at low costs of acquisition and ownership.

Technical innovations like microprocessor control, solid-state write enable sensing, and a design with fewer parts have brought 5000 hour MTBF reliability to half-inch tape.

Our optional *embedded* formatter simplifies interfacing and provides multiple-drive capability of up to four drives. The formatter can be moved from drive to drive quickly, if necessary.

Your customer will appreciate the easy tape loading and quiet operation. Low power consumption and a compact design save energy and space. And this newest member of Control Data's family of OEM tape equipment completes our line—now we can satisfy your requirements for high-speed, medium-speed and low-speed tape peripherals.

Put quality behind your nameplate. For more information, call us at 612/853-3180. In Europe, contact one of our European representatives. Or return coupon to:

Robert C. Urban, Product Sales Manager
Control Data Corporation, P.O. Box 0
Minneapolis, MN 55440

CD 5-0

Tell me more about your new 9214X.

Name_____ Title_____

Firm_____ Address_____

City_____ State_____ Zip_____

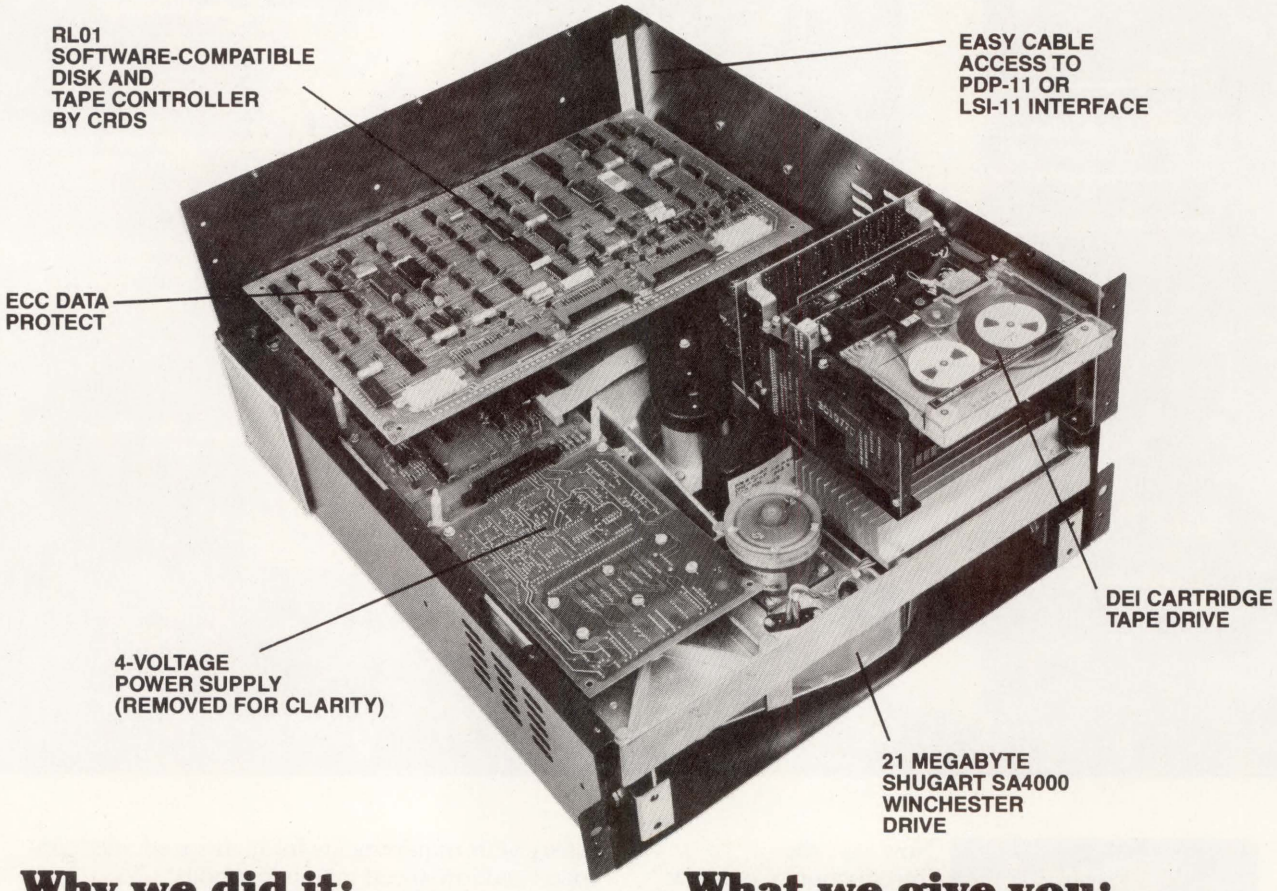
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CONTROL DATA CORPORATION

Addressing society's major needs

CIRCLE 180 ON INQUIRY CARD

The inside story of our DEC-11® Winchester disk system with fail-safe cartridge tape back-up.



Why we did it:

The HD-11 Winchester Disk system is CRDS's fail-safe solution to data loss should the sealed disk ever be unrecoverable.

We've combined the industry-standard Shugart SA4000 Winchester Drive with an optional DEI cartridge tape back-up module. CRDS disk/tape controller, interface cards and all related hardware complete the package. Of course, the HD-11 is RL01 instruction set compatible, and is equally at home in a PDP-11 or LSI-11 based system.

So now you can have an ultra-reliable storage system for the most popular CPU's available, in a familiar software environment, all at a cost many times less than DEC peripherals!

We did it because we knew you needed a system like HD-11. Send for details today. Once you compare prices and check the specs, you'll be glad we did.

What we give you:

In a single, complete 10½" rack-mountable enclosure, you get the equivalent capacity of four RL01's. HD-11 disk-only system single-quantity price is $6,500; backup tape option is $2,200. Plus you get:

- 21 megabyte formatted disk storage
- RL01 instruction set compatible
- 15 MB cartridge tape backup option
- ECC data protect on both disk and tape
- Q-bus and Unibus compatible
- Four write-protect switches
- High-technology controller prevents latency while using bandwidth more efficiently
- 2-way peripheral for most cost-effective, reliable approach to storage applications

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CRDS

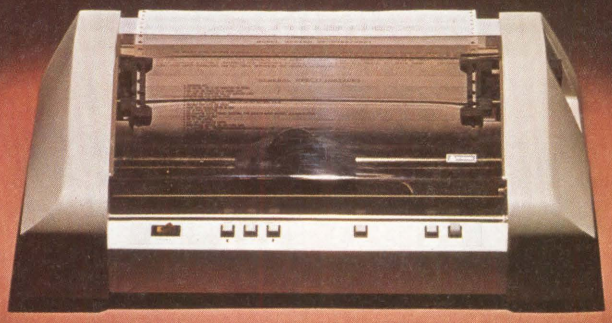
4 Tech Circle, Natick, MA 01760 Tel. (617) 655-1800 TWX (710) 386-0523

See us at NCC, Booth #642

CIRCLE 335 ON INQUIRY CARD

Meet two new Printers from Anadex:

Resolutionary!



Introducing two totally new line printers from Anadex – Models DP-9500 and DP-9501 – offering 132/158/176 and 132/165/198/220 columns, respectively, and featuring true high-density graphics under direct control of the data source.

Both models employ a rugged, Anadex-built 9-wire print head life-tested to 650 million characters. Combining long life with high resolution, this new head provides dot resolutions of 72 dots/inch vertical and up to 75 dots/inch horizontal.

The full standard ASCII 96 character set, including descenders and underlining of all upper and lower case letters, is printed bi-directionally on the original and up to 5 crisp copies at speeds up to 200 CPS. Print densities are switch- or data-source selectable from 10 up to 16.7 characters/inch, and all can be printed double-width by communications command.

The three ASCII compatible interfaces (parallel, RS-232-C, and Current Loop) are standard in both models; so interfacing is usually a matter of "plug it in and print." Also standard is a sophisticated communications interface providing control of Vertical Spacing (6 or 8 lines/inch), Form Length and Width, Skip-Over Perforation, Auto Line Feed, and full point-to-point communications capability.

Other standard features are: forms width adjustment from 1.75 to 15.6 inches, shortest-distance sensing logic, self-test, quick-change ribbon cartridge with 6 million character life, and a 600 character FIFO buffer. (An additional 2048 character plug-in buffer is optional).

For complete details, quantity discounts and a demonstration, contact Anadex today.

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CIRCLE 181 ON INQUIRY CARD

PRODUCTS

PROGRAMMING MODULE FOR 200 DIFFERENT P/ROMS



Unipak allows System 19 programmer users to program more than 200 different MOS and bipolar P/ROMs from several manufacturers. A user keys in via the System 19's hexadecimal keyboard a 4-digit code for a particular P/ROM; the single plug-in module's software assembles the programming algorithm and selects the correct socket for the 16, 18, 20, 24, or 28-pin P/ROM. The algorithm also shortens programming time. The device is easily calibrated to stay within manufacturer's specs. **Data I/O Corp,** PO Box 308, Issaquah, WA 98027.
Circle 233 on Inquiry Card

PRECISION OP AMPS

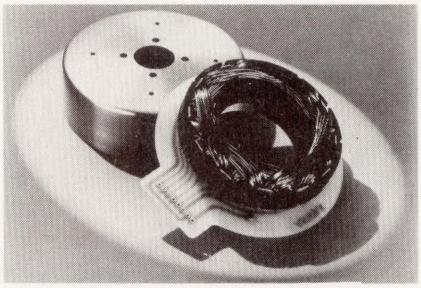
Pin compatible with PMI's OP-01, OP-05, OP-07, and OP-10, models MP5501/OP-01, MP5505/OP-05, MP-5507/OP-07, and MP5510/OP-10 devices feature improved low frequency noise performance. In the 0.1- to 10-Hz range, the MP5507 is available with a 0.3-μV noise performance. Additional characteristics are a high slew rate for DAC followers and improved long-term stability. Packaging includes ceramic DIP, plastic mini-DIP, and TO-99 can. **Micro Power Systems, Inc,** 3100 Alfred St, Santa Clara, CA 95050.
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ZERO INSERTION FORCE CONNECTOR

Most numbers of required contact positions can be provided by Digi-Klip® connectors. Each contact position is an individual segment; these are then stacked together to obtain the necessary number of contacts. Both top and side entry capability are featured. Designed to accommodate a 0.062" (0.157-cm) daughter board, the connector is available in 0.100" (0.254-cm) contact centers, single- or double-sided. Current rating is 2 A/contact. **Components Corp,** 6 Kinsey Pl, Denville, NJ 07834.
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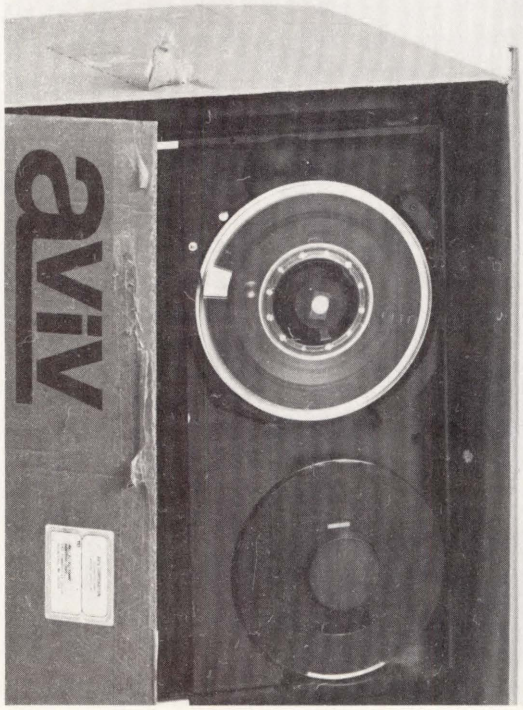
BRUSHLESS DC MOTORS FOR 14" RIGID DISC DRIVES

Designed to replace bulkier ac motors, model K85201, a 24-V brushless dc motor, has a stall torque of 4.9 N•m and a running torque of 0.7 N•m within speeds of 2000 to 3800 r/min. A 4-pole permanent magnet field rotor and 3-phase wye-connected coil stator winding comprise the unit. The commutation function is accomplished by electronic switching and position feedback. **AIRPAX, North American Philips Controls Corp,** Cheshire Industrial Pk, Cheshire, CT 06410.



Circle 236 on Inquiry Card

6250 bpi is available today for DEC & DG users



Aviv's new GCR tape systems

AVIV is delivering GCR tape systems now for NOVA/Eclipse* and PDP-11/VAX** computers. Each offers ANSI/IBM media compatibility in 6250 and 1600 bpi modes, increased data capacity and speed four times over conventional 1600 bpi systems.

AVIV's tridensity 6250/1600/800 bpi tape systems are designed for flexible system configuration, high data integrity and the highest effective throughput in the industry.

•Large record capability.•Read/write "on the fly".•4k FIFO data buffer.•45, 75 or 125 ips drives.•Imbedded controller uses one host computer slot.•2 track error correction.•Software transparent to DEC and DG operating systems.•Comprehensive diagnostics.•From $30,200.

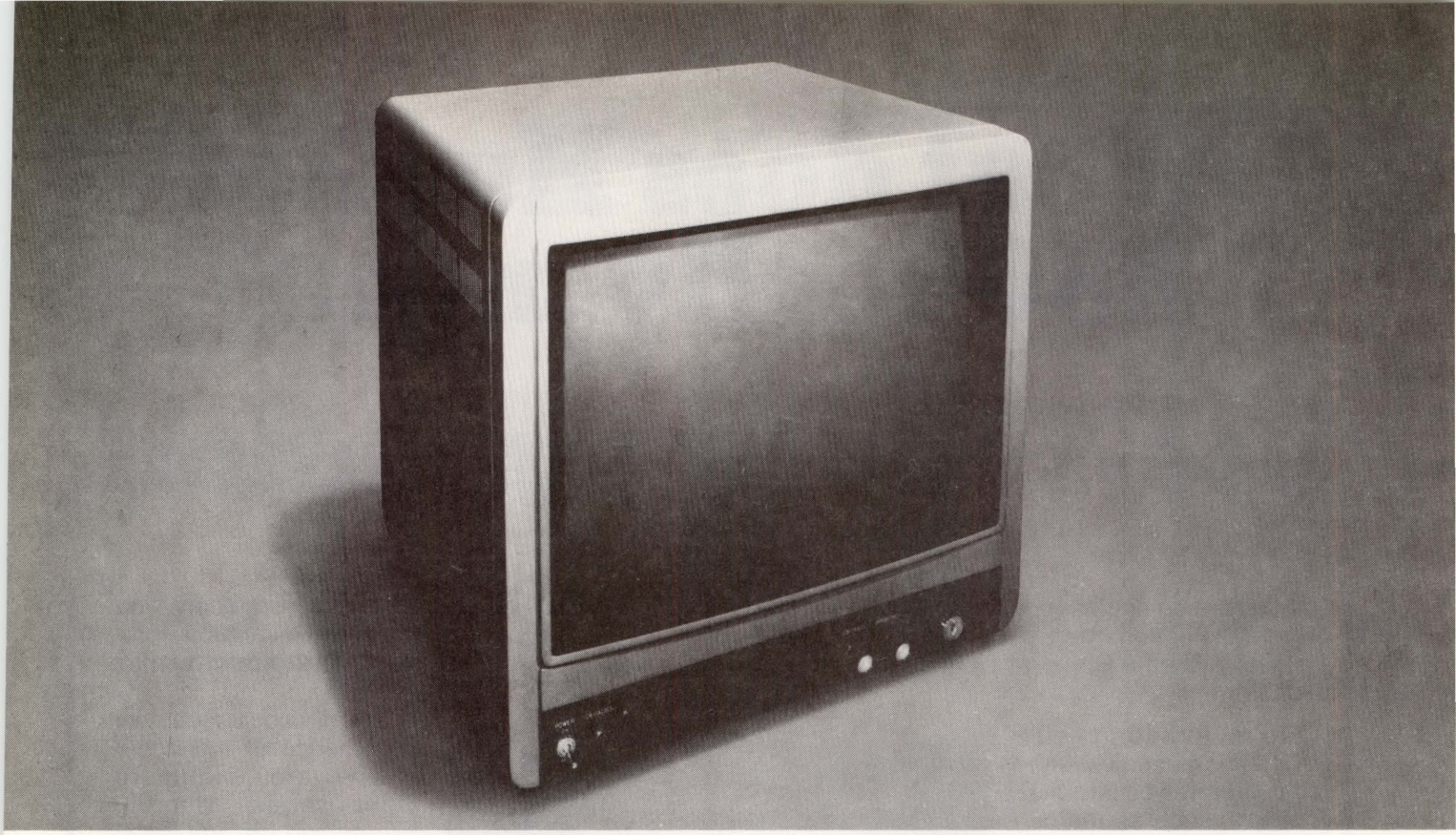
Other AVIV mag tape products: PE and NRZI controllers and systems for NOVA/Eclipse, PDP-11/VAX and LSI-11/23** computers. From $3,100, OEM discounts available.

aviv CORPORATION

Advanced GCR/minicomputer technology.

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(617) 933-1165

* ® Data General Corporation
** ® Digital Equipment Corporation



HITACHI'S NEW IN-LINE GUN RGB COLOR MONITORS ARE SOMETHING TO SEE.

Hitachi helps you see it better with two new high resolution color monitors. Computer data and graphic displays have never been brighter or clearer. Both the HM 2619 and 2613 utilize wide video bandwidth and a 0.31 mm spacing between triad pairs to provide a trio-dot density twice that of conventional models.

On-screen advanced features

These latest Hitachi state-of-the-art monitors embody adjustment-free convergence, single PCB configuration and wide video amplifier bandwidth (from 50 Hz to 25 MHz). The flexible frequencies range from 15 to 18 KHz horizontal and 50 to 60 Hz vertical. The monitors supply high contrast and brightness from black matrix and 85% light transmission tubes.

Behind-the-screen enhancements

Input signals come from RGB video signals with composite sync on green using EIA RS-170 as a guide, or with separate sync signals. Also featured are built-in loopthrough passes for cascading with BNC connectors and a switch selectable impedance for 75 ohms termination of high.

Worry-free operation

Long time convergence stability is assured due to self convergent in-line guns and single PC board reliability. These unique monitors offer the following operator controls; power on/off, degauss, brightness, contrast.

A medium resolution alternative

The model HM 1613 provides economical medium resolution with self convergence and an in-line gun. The dot shadow mask and 0.42 mm dot pitch provide clear viewing under ambient light. The video amplifier bandwidth ranges from 50 Hz to 25 MHz.

Call or write for more information.

HITACHI
Hitachi, Ltd. Tokyo Japan

Hitachi America, Ltd.
San Francisco Office,
100 California Street, San Francisco, Calif. 94111
Tel: (415) 981-7871

CIRCLE 183 ON INQUIRY CARD

See us at NCC Booth 4309

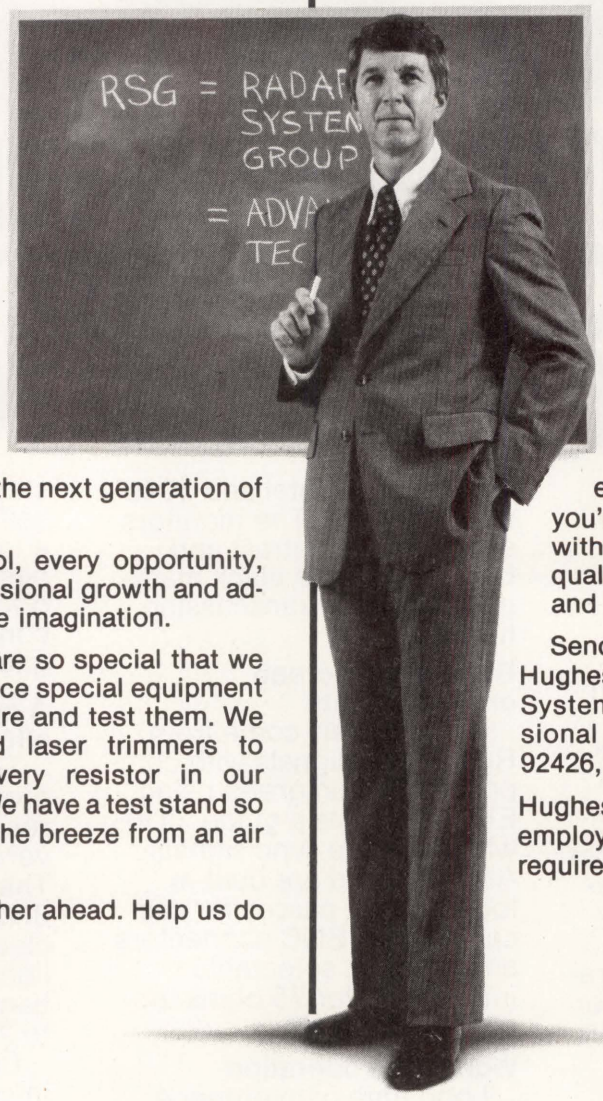
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Use Your Imagination.

If you are an engineer or scientist with a working imagination, there's a place for you in the Radar Systems Group at Hughes in Southern California.

We're creating advanced radar systems for aircraft well into the 1990's, such as the radar that can track more than 20 targets at the same time, and pick out the most threatening, even if they are not the nearest ones.

With that kind of technological excellence already on board, why are we hollering Help Wanted?



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We'll give you every tool, every opportunity, every incentive for professional growth and advancement. You bring the imagination.

The systems we create are so special that we have to design and produce special equipment of our own to manufacture and test them. We use computer-controlled laser trimmers to measure and adjust every resistor in our custom hybrid circuits. We have a test stand so sensitive it can register the breeze from an air conditioner. And more.

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What's beyond our most advanced radars, and CAD/CAM, and our top-of-the-technology processes for fabricating complex components? You tell us.

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Many of the most absorbing projects among the 1,500 in our company's 4½ ***billion*** dollar backlog are here, at RSG. So are many of the brightest computer professionals, electronic and mechanical engineers and scientists. If you're good enough to work with them, the experience will qualify you to move ahead far and fast.

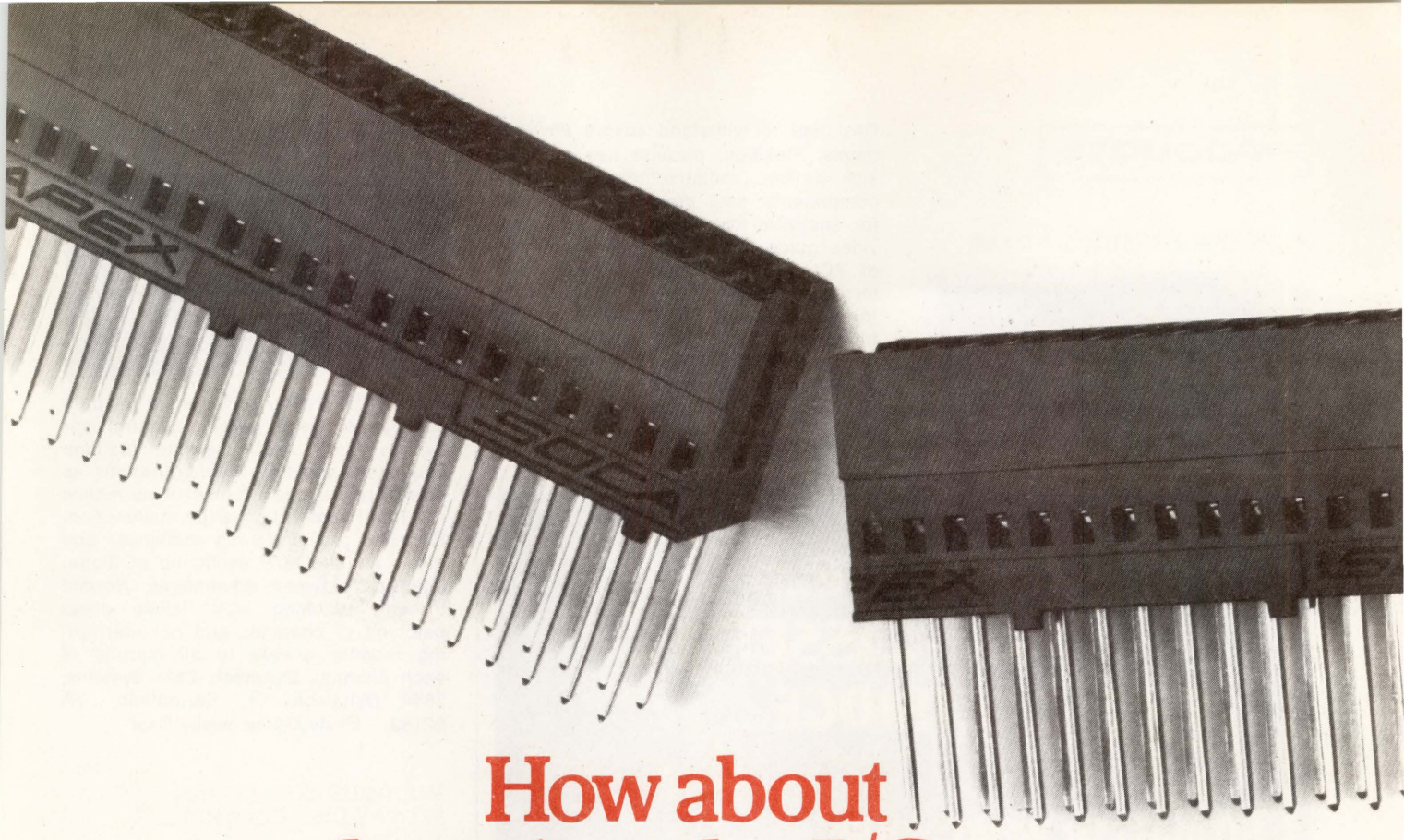
Send your resume now to Hughes Aircraft Company, Radar Systems Dept. DC-5, Professional Employment, P.O. Box 92426, Los Angeles, CA 90009.

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RADAR SYSTEMS GROUP **HUGHES**

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CIRCLE 184 ON INQUIRY CARD



How about changing the P/C connector to fit your design – instead of vice-versa?

Just tell us how many contacts you need—from 2 to 150—and it's yours, right now.

With no special engineering. No custom mold. No lost time. No extra charges.

The secret is in the insulator design of our new Socapex 254 DFT Series. We take the molded connector, cut it to fit your specs—then add the snap-on ears. As simple as that you have a custom connector with from 1 to 75 contact pairs (.100" pitch) with wire-wrap, dip-solder or eyelet tails.

There are some other very nice features, too. For example:

Damaged contacts are easily, quickly changed.



Series 254 DFT
2 to 150 contacts,
snap-on mounting ears.

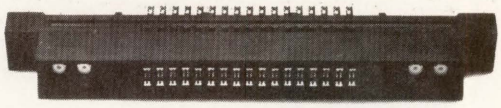
Probing ports let you check any circuit and do it with the power on.

You can't mismatch boards and connectors—special keys prevent it.

And more.

To keep out noise.

For high-speed/low noise circuits, our 254 DFC Series offers matched impedance 50 ohm contacts with low VSWR. They're available with 2 x 17 P/C contacts, plus 4 co-ax contacts. Or 2 x 31 P/C contacts with 6 co-ax contacts, in a two-piece connector.



Series 254 DFC P/C and co-ax contacts.

The 254 DFT and DFC Series. Just tell us what you want and it's yours. Call or write us today for a quote on pricing and delivery.

SOCAPEX

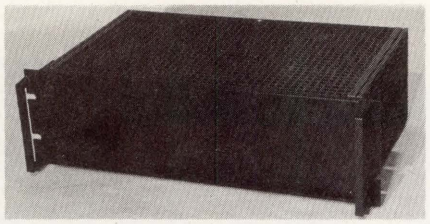
THOMSON-CSF

6660 Variel Avenue/Canoga Park, CA 91303
(213) 887-0750/TWX 910-494-1954/Telex 69-8481

CIRCLE 185 ON INQUIRY CARD

PRODUCTS

MODULAR INSTRUMENT CASE



Designed to withstand severe environments, Flexibox, through use of heat-sink profiles, radiates heat away from components and provides longer life for enclosed instrument. The case provides guide channels for incorporation of PC cards or mounting plates and for skin plates, allowing easy access for service. Using I-bolts several smaller boxes can be locked together. either horizontally or vertically. **Norman R. Sutherland & Assoc, Inc,** 6290 Sunset Blvd, Suite 1126, Los Angeles, CA 90028.
Circle 237 on Inquiry Card



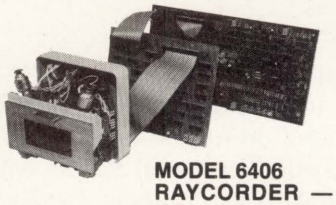
CASSETTE...
MINI-CASSETTE...
CARTRIDGE...

NO MATTER WHAT YOUR SMALL TAPE-DRIVE REQUIREMENT,

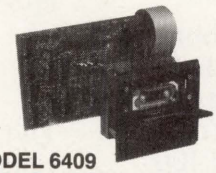
THERE'S A RAYCORDER YOU CAN DEPEND ON.

The Raycorder Products Division of Raymond Engineering Inc. has been building cassette/cartridge tape drives for 10 years. We're the small tape drive experts. Whatever your choice of media — cassette, mini-cassette, or cartridge — Raymond builds a tape drive for all of the standards.

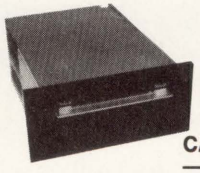
Whether you require an OEM drive with typical tape recorder interface, a standard interface such as RS232C or IEEE 488, a custom interface, or a stand-alone system, Raymond builds the configurations that you want. Our software driven interfaces provide the flexibility to make this possible. Let us show you how.



MODEL 6406 RAYCORDER — Popular since 1970, now with all new electronics.



MODEL 6409 MINI-RAYCORDER — A proven performer in a tiny package — many new features.



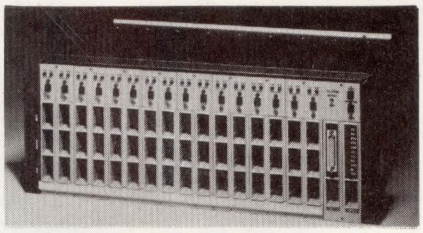
MODEL 6413 CARTRIDGE RAYCORDER — Fast becoming the standard by which others are judged.



MODEL 6801 RAYCORDER CASSETTE TERMINAL — A stand-alone terminal with a virtually unlimited number of operating modes.

Raycorder Products Division
Raymond Engineering Inc.
217 Smith Street, Middletown, Connecticut 06457·(203) 632-1000

MULTICIRCUIT SWITCHING MODULE

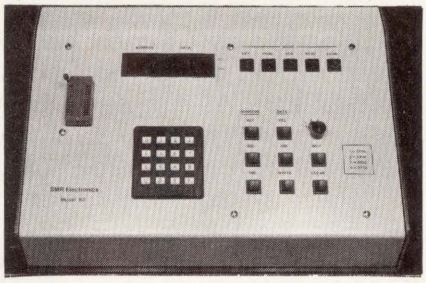


Providing a transparent system for data management and network control activities, Mark II-EM permits realtime equipment and line reconfigurations as part of operational routine or as means of circuit restoration after malfunction. Switcher provides both individual and group channel A/B switching of digital interface between equipments. Normal through patching jacks allow cross patching of channels and noninterrupting monitor access to all circuits of each channel. **Dynatech Data Systems,** 7644 Dynatech Ct, Springfield, VA 22153. Circle 238 on Inquiry Card

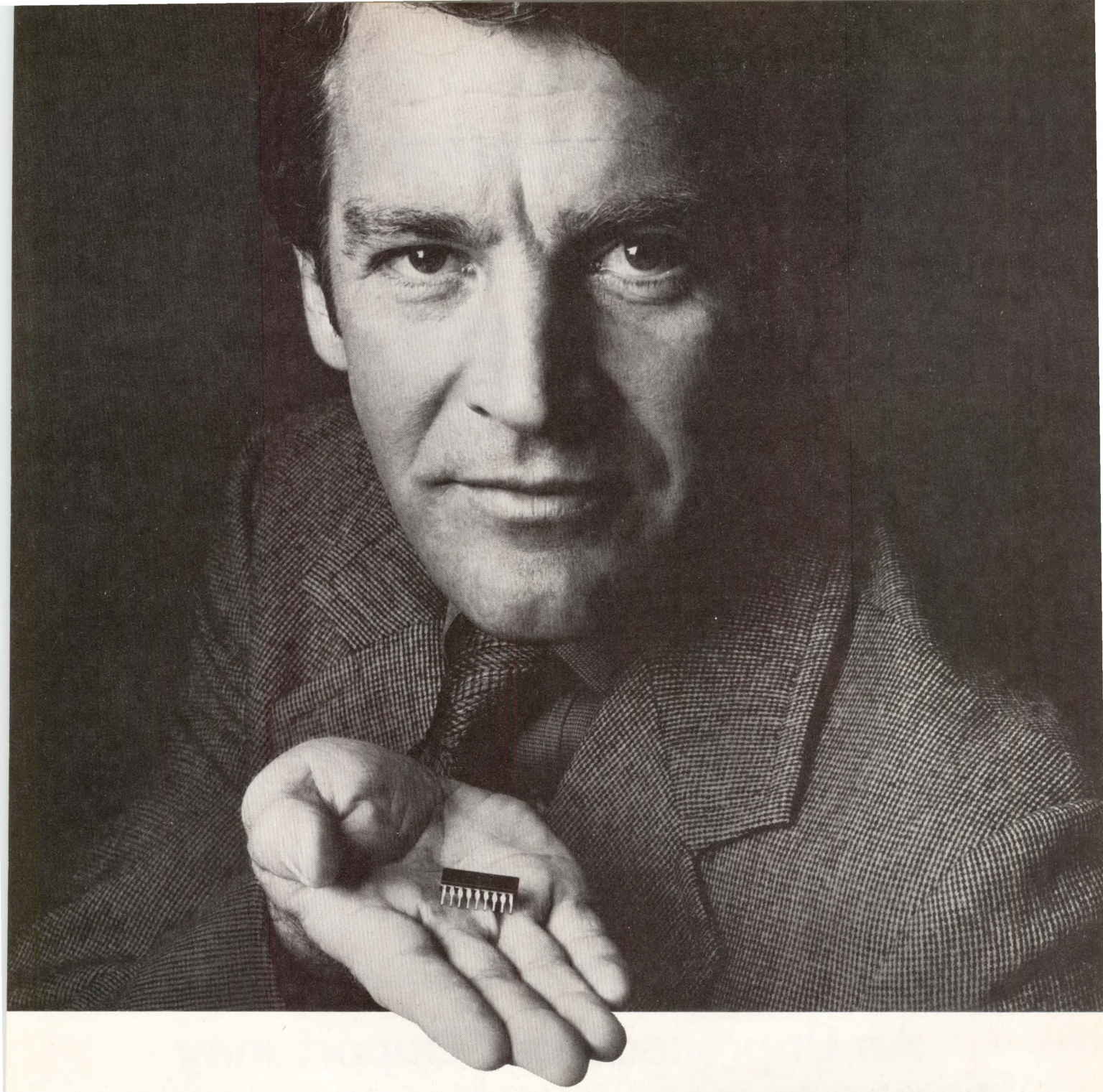
MULTIBUS COMPATIBLE FLOPPY DISC CONTROLLER

Smart controller compatible with the Intel Multibus, the FDC-110 provides all control functions required for formatting, sector read/write, drive select, and head positioning for 1 to 8 Shugart compatible floppy disc drives. The programmable 8085 based controller reads and writes IBM compatible diskettes, and incorporates 4k RAM and 8k P/ROM. It is CPM software compatible with a flexible command set which can be queued. **Professional Resources Technology,** 504 Vandell Way, Bldg E, Campbell, CA 95008.
Circle 239 on Inquiry Card

EPROM PROGRAMMER



A self-contained programmer for single-supply EPROMs, model 80 can program 2758, 2516, 2716, 2532, and 2732 EPROMs to manufacturer's specs, and make copy EPROMs from a master. Editing capabilities allow insertion and deletion of data with resequencing prior to programming. Programs are entered via the panel keyboard or optional serial interface. 2-h rechargeable backup battery prevents data loss during power interruption. **SMR Electronics,** 3 Haven Rd, Medfield, MA 02052. Circle 240 on Inquiry Card



GERMANY KNOWS TOSHIBA DELIVERS 4 MILLION 4K CMOS RAMs EACH YEAR.

They know we don't just talk. We deliver. Two 1K x 4 RAMs (one with the popular 2114 pin-out) and a 4K x 1 RAM with latched Address inputs. All feature ultra low power CMOS technology, and single 5V power supply. All are static and offer TTL compatible 3-state output.

Yes, they know about Toshiba in Germany. The rest of the world knows. too. Isn't it time you found out?

TOSHIBA AMERICA, INC.

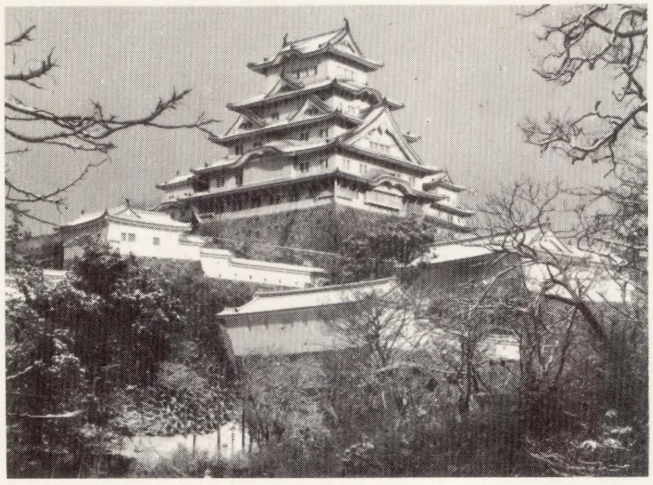
People around the world have fond memories of us.

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CIRCLE 187 ON INQUIRY CARD

Preview the 80's at the
8th World Computer Congress

Tokyo
October 6-9, 1980



Melbourne
October 14-17, 1980



Here is a chance without equal to be part of what promises to be one of the most rewarding and significant international computer congresses ever held.

For the first time in its 21-year history of gathering together the world's foremost information scientists, the Eighth World Computer Congress (IFIP 80), sponsored by the International Federation for Information Processing, will be held in the Asian/Western Pacific Region where the growth of computer technology and applications has been most dynamic in recent years.

Japan and Australia are your hosts for this distinguished triennial worldwide gathering. And they cordially invite all Americans involved with computer sciences and automated information systems to pursue their professional interests in the context of their two cultures. Join with representatives of 39 participating IFIP countries to witness and help shape the direction that information processing will take in the decade ahead.

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Applicable Computers – PDP-11/45, PDP-11/50, and PDP-11/55.

Run and Response Time – Run time reductions up to 67% make possible the same amount of computing functions in 33% of the time required without SCAT/45.

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CIRCLE 188 ON INQUIRY CARD

See Able products booth 3411, NCC, Anaheim



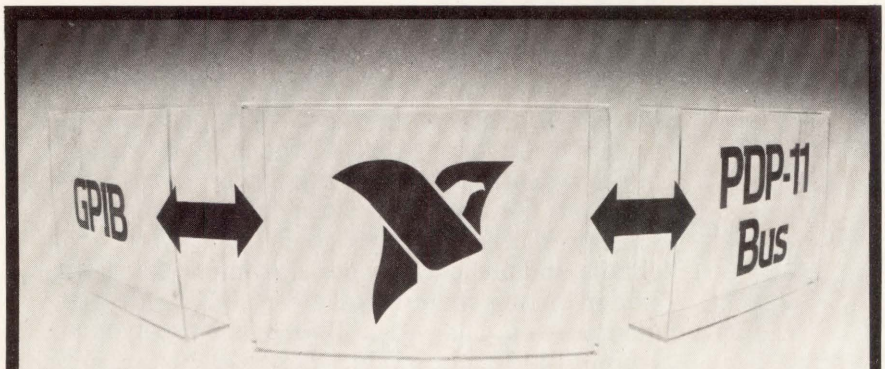
PRODUCTS

METRIC MOTOR LINE FOR INTERNATIONAL STANDARDS



Line of 62 ac motors, torque motors, and parallel-shaft and right-angle gearmotors meets most European and international electrical and safety specs or recommendations. The units satisfy or exceed IEC specs for rotating electrical machines and motor operated appliances, as well as national requirements such as those issued by Great Britain (BSI) and West Germany (VDE). All carry an international enclosure rating. **Bodine Electric Co,** 2500 W Bradley Pl, Chicago, IL 60618.

Circle 241 on Inquiry Card



National offers complete PDP-11 Interface systems for your IEEE-488 Bus.

Interface Hardware
National Instruments is an instrumentation specialist in GPIB products. The GPIB11 series of plug-in cards for your UNIBUS™ or Q-BUS™ handles all handshake protocols for controlling and moving data between multiple instruments on the GPIB. Performs talker, listener, controller, system controller and extended addressing functions.

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We've developed complete software packages which can be edited to do what you want, in the language you want. Software is provided as MACRO source files for use with FORTRAN, BASIC or MACRO under the RT-11™ and RSX-11™ operating systems. Optional software is available for UNIX™ operating systems. User level calling syntax is identical for all interface cards. We provide full software consultation for all our systems.

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To provide the best service and quality, our products are available from stock and carry a one year warranty.

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National Instruments provides complete GPIB Interface packages with full support. For detailed information on products and accessories, contact:

NATIONAL INSTRUMENTS

8900 Shoal Creek Building A117 Austin, Texas 78758 512/454-3526

FLAT CABLE CONNECTORS

Flat cables are permanently connected to PC boards by DIP soldering, without wire stripping. Mass terminating system allows termination of 0.05″ (0.127-cm) center spaced, flat cables of 10 to 60 conductors. U-shaped contact preserves gas tight, positive connection. Contacts are solder plated over nickel. Dual-inline terminals and 0.209″ (0.531-cm) profile above the PC board are other features of the FCN-730 series. **Fujitsu America, Inc, Component Sales Div,** 910 Sherwood Dr-23, Lake Bluff, IL 60044.

Circle 242 on Inquiry Card

A-D AND D-A CONVERTERS

ACD-14-QM offers conversion time of 50 μs and differential linearity of $\pm\frac{1}{2}$ LSB max over a temp range of 0 to 70 °C. With selectable input ranges of $\pm$10, $\pm$5, 0 to 5, and 0 to 10 V, the device has differential nonlinearity and offset tempcos of less than $\pm$5 ppm/°C. A 4-quadrant, 15-bit multiplying DAC, M-DAC-15 has 10-μs analog settling time to 0.01%, 5-μs digital settling time to 0.01%. Feedthrough capacitance is a 5.0 pF typ, dc accuracy is $\pm$0.0031% of FS. **Intech Function Modules,** 282 Brokaw Rd, Santa Clara, CA 95050.

Circle 243 on Inquiry Card

ADC MODULES FOR DATA ACQUISITION SYSTEM

Converters containing 2 interface input registers and 1 interface output register offer 12- or 14-bit configurations with 1 to 16 differential input channels. Inputs range from 32 to 4096 mV full scale. Full-scale settling time is $<$500 μs to within 1 LSB. Onboard attenuation circuits allow extension of the input voltage to several hundred volts. The module reads thermocouples, 4- to 20-mA process signals, strain gauges, and other voltage or current signals. **Androtek/dmi,** PO Box 29098, Columbus, OH 43229.

Circle 244 on Inquiry Card

PROGRAMMER PANEL FOR ARRAY PROCESSOR

Program development aid gives direct visual access to information, which is useful in situations where the programmer is developing a new array function. The model 7140 panel used in conjunction with MAP LOOK and MAP SIMULATOR diagnostics debugs assembly language or FORTRAN programs. The programmer can visually inspect the status of I/O queues and program counter information for individual internal AP processors. **CSP Inc,** 40 Linnell Cir, Billerica, MA 01821.

Circle 245 on Inquiry Card

DILOG CONTROLS DEC 11*

disc and magnetic tape with single quad board controllers for LSI-11*, 11/2, 11/23, and PDP11*. Each reduces your power, space and interface time . . . they simply plug into one bus slot of your CPU . . . and at a low cost too.

Dilog (Distributed Logic Corp.) is now the **only** firm offering you all these intelligent hard disc and magnetic tape products for your CPU on single quad size boards.

COMMON FEATURES of Dilog products include • single quad size board • no external power or chassis . . . just a cable to connect to the drive—you don't need anything else! The low cost simple designs employ proprietary sophisticated bipolar μPs so you benefit with • increased reliability • automatic self-test including data base protect feature and indicator.

NEW LSI-11 DUAL DENSITY MAGNETIC TAPE COUPLER, Model DQ130 interfaces dual density (NRZI/PE) imbedded formatter tape drives • handles up to eight drives • emulates TM-11* • handles new drive innovations, such as "streamer" mode • RT-11/RSX-11* compatible • 800 CPI NRZI or 1,600 CPI PE formats • speeds 12.5 to 125 ips • transfers data via DMA facility at rates to 200,000 characters per second • buffers data and status transfers between units.

LSI-11 μP TAPE CONTROLLER, MODEL DQ120 emulates the TM-11*/TU10* and interfaces industry standard drives including both 7 and 9 tract NRZI ½-inch tape drives with 7, 8½ or 10½" reels at speeds up to 112.5 ips.

PDP-11 μP TAPE CONTROLLER, Model DU120 emulates TM-11*/TU10* and offers you 30-50% saving when used with industry standard drives.

NEW LSI-11SMD/ WINCHESTER/CMD DISC CONTROLLER, Model DQ200 interfaces any two removable media or Winchester drives with SMD interface • cost savings over 40% and up to 50% savings on power and space • soft sector format offers 20% more disc storage • on-board bootstrap loader provides automatic startup • controls industry standard Winchester, SMD (pack), CMD (cartridge) drives • mix drive types • drive capacities to 300 MB.

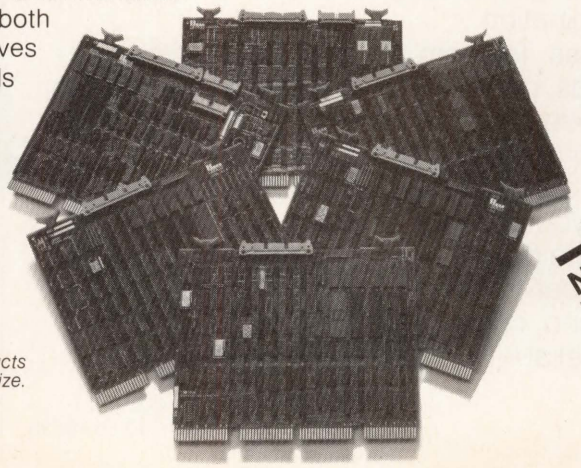
PDP-11 μP DISC CONTROLLER, Model DU100 is an RK-11*/RK05* emulator that supports all 2.5, 5, 10 and 20 MB industry standard cartridge class disc drives • expanded addressability to 40 MB.

LSI-11 μP DISC CONTROLLER, Model DQ100 emulates RKV11*/RK05* and offers the same benefits as DU100.

PRICING for Dilog controllers is competitive or lower than any product you'll find on the market . . . either individually or in OEM qtys. Fast delivery from stock to 30 days A.R.O. and solid warranty.

COMPLETE SYSTEMS including drives also available.

Write or call for detailed product performance data on these 6 Low Power, quad DEC-11 products, or soon to come new products. Distributed Logic Corp. 12800-G Garden Grove Blvd. Garden Grove, CA 92643 Phone (714) 534-8950



All Dilog μP Products are Low Power, Quad Size.

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NEW

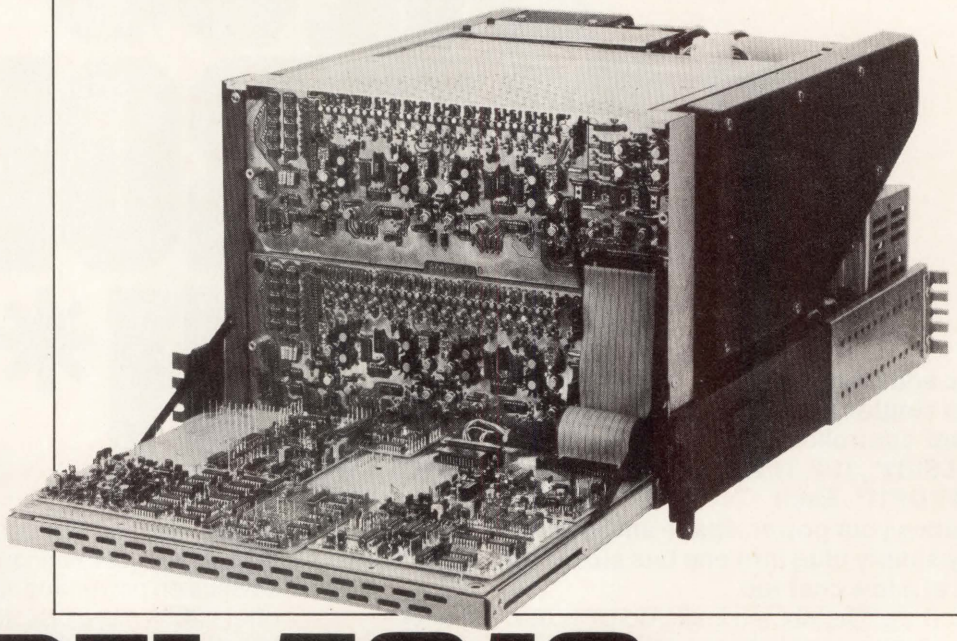
- LSI-11 Shugart SA4000 Winchester Controller
- PDP-11 Magnetic Tape Coupler
- PDP-11 SMD Controller
- 8" Winchester Controllers

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NCC ANAHEIM BOOTH 3110

CIRCLE 190 ON INQUIRY CARD

RELIABILITY: 28,000 hr. MTBF.
ECONOMY: .035 cents per bit.



VRC MODEL 4016 MEMORY

CAPACITY . . .	37.9 million bits
BIT RATE	4.33 MHz
ACCESS TIME	8.5 m/sec.
DIMENSIONS	Height – 12¼" (31.2 cm.) Width – 17½" (44.5 cm.) Depth – 22" (55.9 cm.)
MEAN TIME TO REPAIR . .	Less than 1 hr.

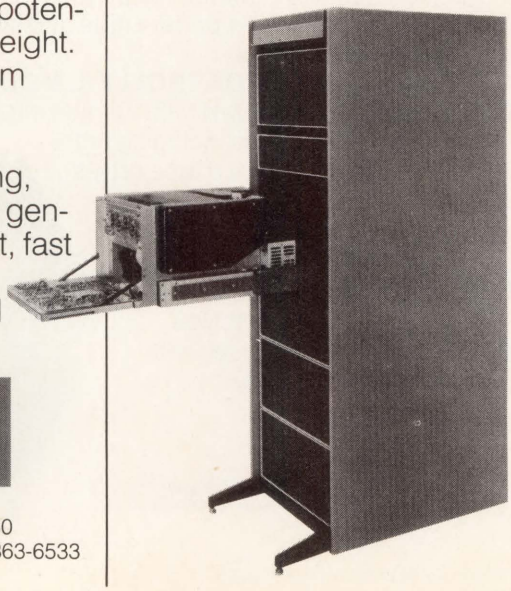
When it comes to speed, reliability and low cost, systems users in 25 countries in every continent of the world depend on the VRC 4016 head-per-track memory.

It features a fail-safe actuation system that eliminates the potential of media damage and data loss. It's compact and lightweight. All electronics, drive components and head retraction system are mounted outside the drum, making service simple and eliminating risk of contamination.

Applications are endless. Telecom and message switching, process control of all kinds, geophysical exploration, power generation, news editing, typesetting. Wherever low cost-per-bit, fast access and high data storage capacity are required.

For proven reliability, worldwide support, field service and predictable high quality, you can rely on VRC.

Write or call for complete details on the Model 4016 head-per-track memory...a simple, rugged, compact unit to improve the reliability of your system.



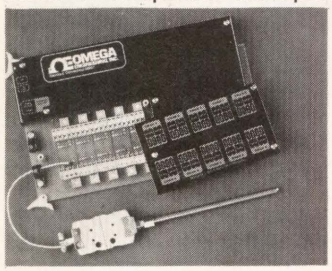
Vermont Research
CORPORATION

Precision Park
North Springfield, Vermont 05150
Tel. (802) 886-2256, TWX: 710-363-6533
FAX (802) 886-2682

PRODUCTS

TEMPERATURE MEASUREMENT ACQUISITION MODULE

Series OM100 modules can accommodate any mixture of thermocouples, thermistors, or RTDs to provide a modular software solution to a temperature sensor termination. The series of compatible microprocessing systems includes the

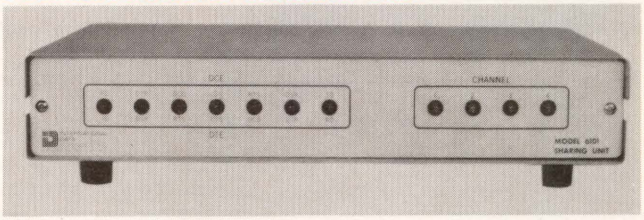


OM101 10-channel reference junction featuring a precision iso-thermal assembly, the OM102 10-channel thermocouple scanner incorporating Auto-Ice™ zero stabilization, the OM110 linearizing ADC that digitizes up to 160 channels, the OM111 ASCII interface for online error detection, the OM115 10-channel RTD scanner, and the OM104 10-channel universal scanner featuring low drift amplification. OM108, a 19″ (48-cm) rack panel, houses up to 50 channels. **Omega Engineering, Inc,** 1 Omega Dr, Stamford, CT 06907. Circle 219 on Inquiry Card

MICROPROCESSOR BASED SONIC DIGITIZER

GP-series 6 digitizers provide digital coordinates of any point on a plane with a standard BCD cartesian (X, Y) output. Model GP-6-40 incorporates additional firmware for area, line length, and variable scaling computations. It allows automatic calculation of area within any figure on the plane, length of traced lines, and selection of a derived scale by alphanumerical ASCII menu instruction. Input to the digitizers is from a stylus or a cursor with crosshairs. The stylus contains both sonic energy generating gap and ballpoint ink cartridge. A plastic nonscratching stylus is supplied for use with CRT displays. **Science Accessories Corp,** 970 Kings Hwy W, Southport, CT 06490.
Circle 220 on Inquiry Card

COMMUNICATIONS SHARING UNIT



Model 6101 allows varied combinations of up to 4 modems or data terminals to share a common communications device. Modems and terminals can be up to 50′ (15 m) from the sharing unit, allowing a maximum separation of up to 100′ (30 m) between common and distributed devices. The unit operates up to 19.2k bits/s in synchronous and asynchronous modes. Front panel LEDs indicate the status of TD, RD, RTS, CTS, DCD, DSR, and DTR on the common side. An RTS/CTS time delay selected on a channel by channel basis is provided when the unit interconnects a common data terminal to distributed equipment. **International Data Sciences, Inc,** 7 Wellington Rd, Lincoln, RI 02865.
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Your future's in the cards, so you'd better have aces.*

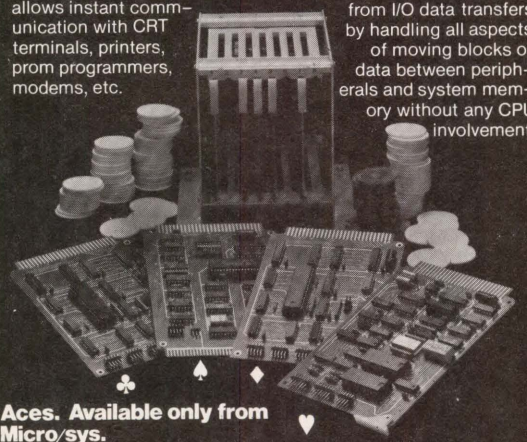
And Micro/sys deals in nothing but aces. Powerful STD BUS cards, the CP/M† Disk Operating System, and complete STD BUS development systems. You can't lose.

♠ **Our SB8500 Floppy-Disk Controller** card was the first to provide double density capability for STD BUS systems.

♥ **Our SB8420 Dual RS232C Interface with Bootstrap** allows instant communication with CRT terminals, printers, prom programmers, modems, etc.

♣ **Our SB8301 Priority Interrupt Controller** gets your CPU to the proper interrupt service routine instantly.

♦ **And our SB8341 Four Channel DMA Controller** lets you unload your CPU from I/O data transfers by handling all aspects of moving blocks of data between peripherals and system memory without any CPU involvement.

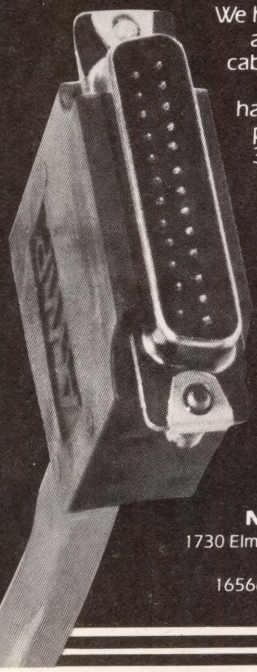


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CIRCLE 192 ON INQUIRY CARD

RS-232C Interface Cables



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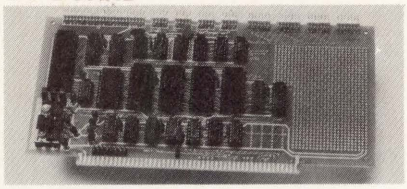
NEC

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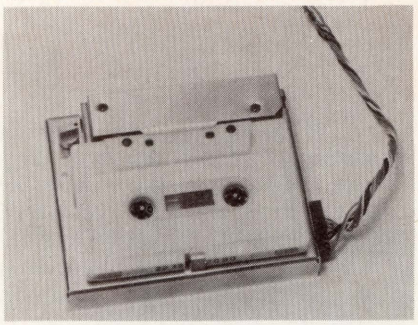
PRODUCTS

MULTI-USER S-100 I/O BOARD



Board consists of 4 RS-232 serial ports with 8551 UARTs for full handshaking capability, 3 programmable timers, 2 bus driving parallel output ports, 3 parallel input ports with handshake capability, and wirewrap area for custom circuitry. Serial ports have separate switch selectable rates to 9600 baud. An 8253 programmable interval timer is configured as a realtime clock for generating periodic system interrupts. **Micromation,** 1620 Montgomery St, San Francisco, CA 94111.
Circle 246 on Inquiry Card

REMOTE SITE DATA LOGGER



Performing unattended collection of digital information, LTD-800 operates for up to 24 h on a single 300′ (91-m) cassette, drawing as little as 7 to 10 mA at 5 Vdc. Std selectable speeds range from 0.040 to 0.75 in (0.101 to 1.91 cm)/s. Data capacity of up to 2M bytes is achievable at a density of 800 bits/in (315/cm). Operation may be continuous or intermittent. Power consumption is 35 to 100 mW nom. **Braemar Computer Devices, Inc,** 11950 Twelfth Ave S, Burnsville, MN 55337. Circle 247 on Inquiry Card

1.8° STEP MOTORS

Permanent magnet units offered in 2 frame sizes of 2.248″ (57 mm) and 3.386″ (86 mm) dia, have a std step angle of 1.8° (0.9° half-step) with step accuracy of ±3% noncumulative. Lengths range from 1.5″ (38.7 mm) to 5.0″ (127 mm). Holding torques are from 27 to 450 oz-in (0.19 to 3.18 N•m). Motors can be driven by unipolar R/L, bipolar R/L, or bipolar chopper drivers. Speeds to 10k steps/s can be achieved with a properly designed control system. **Globe Motor Div, TRW, Inc,** 2275 Stanley Ave, Dayton, OH 45404.
Circle 248 on Inquiry Card

N/C TAPE CHECKER WITH CHARACTER COUNTER



Counter Option to the Tape Checker consists of a 2-decade, solid state counter, a 2-digit display, and an 8-station miniature switch assembly. A push-button switch resets the counter and its display to 0. Each time the device reads a tape char that is identical to the code set into the switch assembly, the counter increments and the total count is displayed. The option speeds up the location of specific program blocks on the tape. **Datacq Corp,** PO Box 3200, Monterey, CA 93940.
Circle 249 on Inquiry Card

PROCESS COMPUTER SYSTEMS ENGINEERS

Join Aramco Services Company in Houston for top salaries, unique experience

When Aramco Services Company, a wholly owned subsidiary of Aramco, the largest oil-producing firm in the world, hires you as a process computer specialist, you'll get a top salary. Plus a great benefits package. You'll also be starting out on what could be a very rewarding Aramco career position.

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Aramco is the key firm involved in the development of the energy resources of Saudi Arabia.

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This could be the job you've waited for

In this key job supporting major Aramco projects, we require *process computer software engineers* with BS degrees in engineering, math or computer sciences, and 3 or more years' experience in various real-time processes or SCADA projects.

We also need *process engineers* with BS degrees in chemical engineering, and 3 or more years' experience in designing and maintaining process computer and instrumentation systems.

Process computer hardware systems engineers are needed with BS degrees in electrical engineering, computer science or engineering technology, plus 3 or more years' experience in designing and maintaining process computer and instrumentation systems.

You'll be based in Houston, but from time to time you will be required to travel to vendors in the U.S. and to field sites in Saudi Arabia.

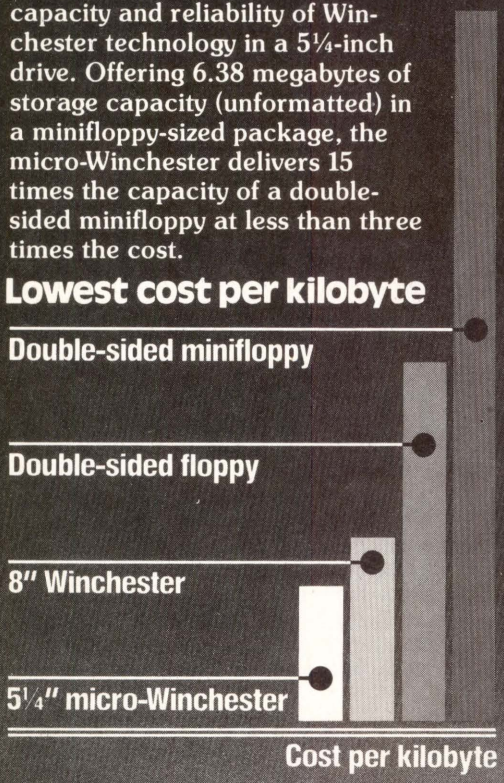
Interested? Send us your résumé and we'll get back to you very soon. Write: Aramco Services Company, Section DOM, Dept. COD050180JLSA, 1100 Milam Building, Houston, Texas 77002.

ARAMCO/HOUSTON
SERVICES COMPANY, DOMESTIC

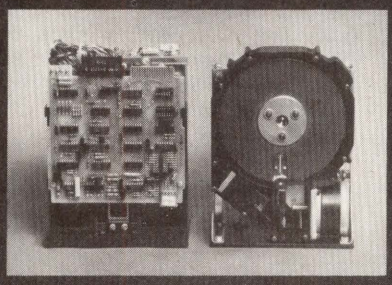
Al Shugart delivers the first 5 1/4-inch micro-Winchester

The developer of the original OEM floppy has done it again. He has packaged the performance, capacity and reliability of Winchester technology in a 5¼-inch drive. Offering 6.38 megabytes of storage capacity (unformatted) in a minifloppy-sized package, the micro-Winchester delivers 15 times the capacity of a double-sided minifloppy at less than three times the cost.

Lowest cost per kilobyte



The perfect marriage– Minifloppy and micro-Winchester



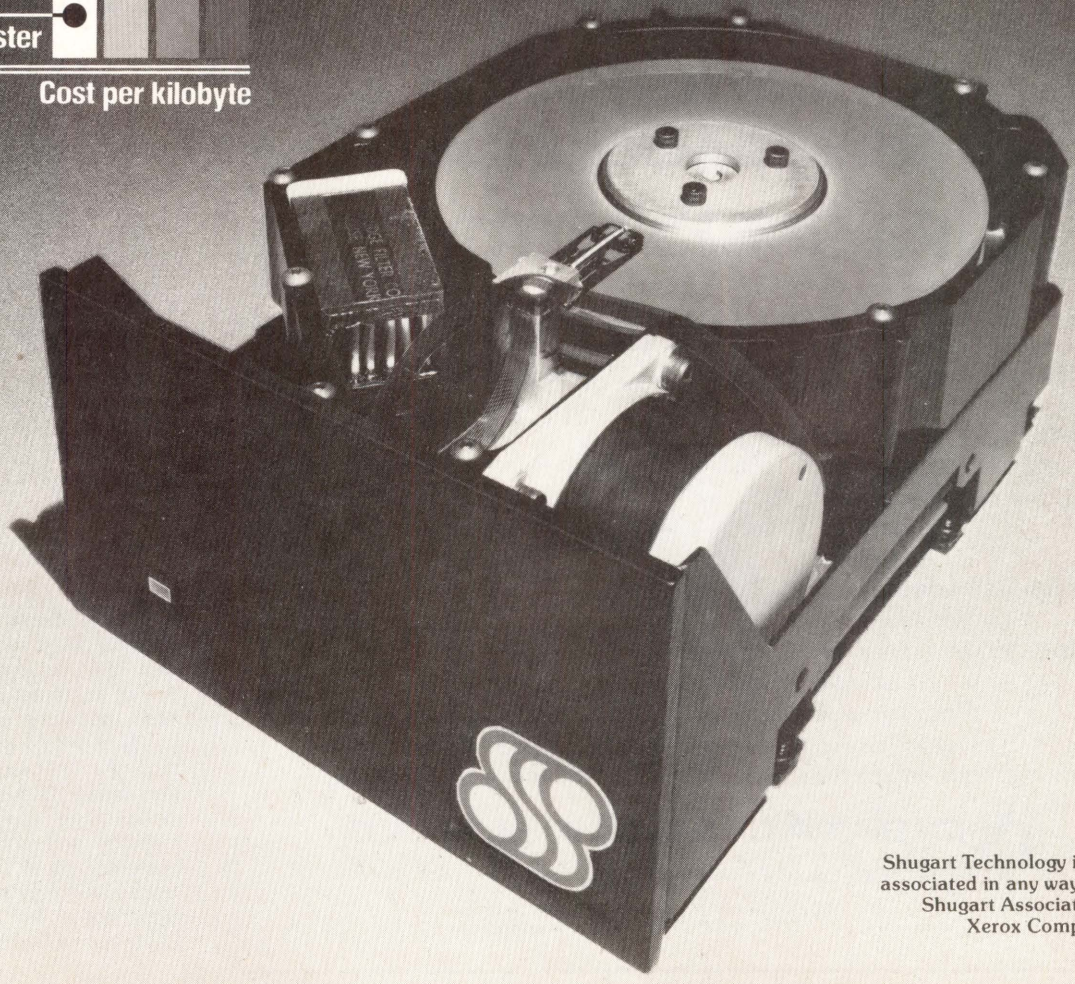
Use micro-Winchester with a minifloppy. Get Winchester's faster access time and data rate. Average access time is 170 milliseconds, almost twice as fast as the minifloppy's 298 milliseconds. Data rate? In one second, the micro-Winchester transfers five megabits compared to the minifloppy's ¼ of a megabit. Save your minifloppy for low-cost backup and system I/O.

It's easy to integrate micro-Winchester with your existing minifloppy-based system. Like the minifloppy, the micro-Winchester has dimensions of 5¾" by 3¼" by 8". It uses the same voltages (+12 and +5) and requires no A.C. power.

The micro-Winchester is real. You can see hard-tooled production models while at NCC. For an invitation and a comprehensive technical brochure, check our readers' service number or call Finis Conner.

Shugart Technology

340 El Pueblo Road,
Scotts Valley,California
95066
(408) 438-6550

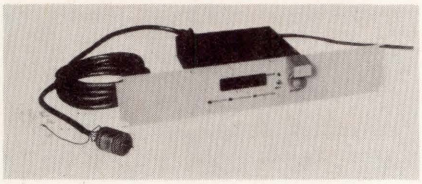


Shugart Technology is not associated in any way with Shugart Associates, a Xerox Company.

CIRCLE 195 ON INQUIRY CARD

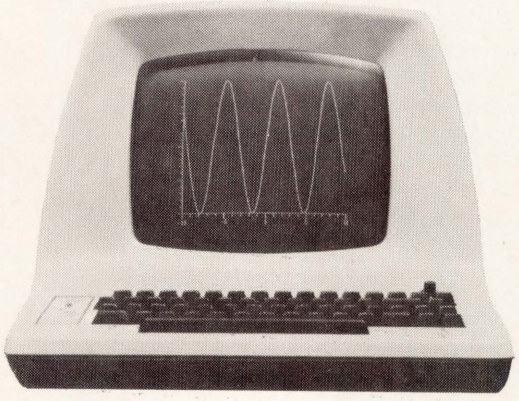
PRODUCTS

SCALABLE ABSOLUTE ENCODERS FOR SEVERE ENVIRONMENTS



Suited to severe electrical (emi) and physical (high temp, vibration, and moisture) environments, units convert any shaft input to BCD or binary information corresponding directly to shaft angle with accuracy of ±1 part in 3600. In addition, 3-, 4-, or 5-digit, 0.5″ (1.27-cm) LED displays of that angle are available. Update rate is 2.5 ms. Data outputs are TTL compatible, and data transfer and data hold line allow simple interfacing to computer. **Computer Conversions Corp,** 6 Dunton Ct, East Northport, NY 11731.
Circle 250 on Inquiry Card

Smart move

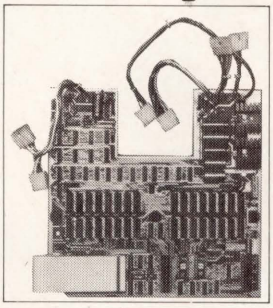


for a dumb terminal.

Retro-Graphics™

Retro-Graphics transforms the ordinary Dumb Terminal into a sophisticated graphics terminal. Check these features:

Packaging: Mounts inside the Lear Siegler ADM-3A. Installation requires no cutting or soldering.



Performance: Microprocessor based. Generates graphs and pictures on a 512 by 250 plotting grid.

Compatibility: Tektronix Plot 10 software compatible. Replaces Tektronix 4006's, 4010's and 4025's in many applications.

Affordability: $1150.00 Domestic single unit price. Retro-Graphics is now available through US and European distributors. Call or write today for details.

DIGITAL ENGINEERING
INCORPORATED
1775-C TRIBUTE RD. • SACRAMENTO, CA 95815 • (916) 920-5600

Lear Siegler and Dumb Terminal are registered trademarks of Lear Siegler Inc.
Tektronix, 4006, 4010, 4025 and Plot 10 are registered trademarks of Tektronix Inc.

MINI-FLOPPY DISC POWER SUPPLY

Dual-output power supply delivers up to 55% efficiency with main channel outputs of 5 V at 0.75 A (peak) and secondary channel outputs of 12 V at 1.8 A. Strap selectable inputs are 103 to 127/206 to 254 Vac, single-phase 47 to 440 Hz. Std features are overvoltage (on 5-V output), overload, short-circuit, and reverse voltage protections. Model FD101 provides line regulation of ±0.5% for a ±10% input line change, static loads of 50 to 100%. **Powertec, Inc,** 20550 Nordhoff St, Chatsworth, CA 91311.
Circle 251 on Inquiry Card

PCB MOUNTING, LED INDICATORS

LEDs are at right angles to the base mounting pins of the series 5320/5321 assemblies, which are positioned, respectively, 0.35″ (8.9 mm) and 0.45″ (11.4 mm) above the board. Pins are pressed into holes in the PC board to provide precise LED location. Mounting base includes a board standoff to prevent flux entrapment and to permit cleaning. Red, green, and yellow LEDs feature a high dome lens that permits max light output over a 90° viewing angle. **Industrial Devices, Inc,** 7 Hudson Ave, Edgewater, NJ 07020.
Circle 252 on Inquiry Card

LOW RFI/EMI DC/DC POWER SOURCES

The u 25 series high reliability, low interference power sources provide 70 to 80% efficiency (typ). Applications include mobile, unattended, and remote installations. The thin profile power supplies feature a 9- to 36-Vdc input range; single, triple, and quadruple outputs; reverse polarity protection; and over/under voltage protection. Outputs range from 5 Vdc at 5 A to quad outputs of ±5 Vdc at 1 A and ±12 Vdc at 300 mA. **MIL Electronics Inc,** 176 Walker St, Lowell, MA 01854.
Circle 253 on Inquiry Card

QUAD-OUTPUT 175-W SWITCHERS

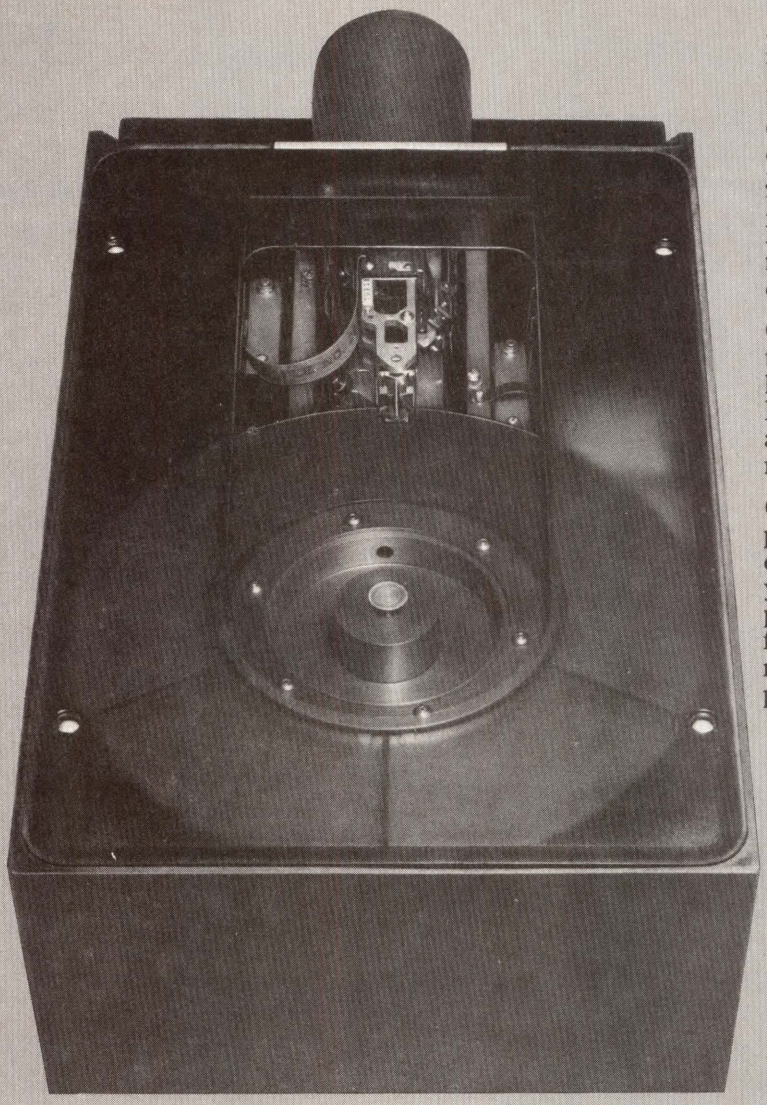
SQ175 series switching power supplies offer 63 open and closed frame models with nom efficiencies of 70%. Main output is rated 5 V at 20 A; 3 regulated auxiliary outputs range from 5 to 28 V each with current ratings up to 5 A. Features include a 117/234-Vac input, 20-ms loss of line holdup, input surge current limiting, and differential and common mode emi suppression. All 4 outputs are fully regulated. **Deltron, Inc,** Wissahickon Ave, North Wales, PA 19454.
Circle 254 on Inquiry Card

Introducing the new BASF 6170 Series 210mm Fixed Disk Drives.

High Performance. Perfect for multi-user multi-tasking applications, the BASF 6170 Series drives give you an average time-to-data of 50 milliseconds... four to seven times faster than standard 8" floppy drives.

Capacity. The BASF Model 6171 provides 8 megabytes and the Model 6172 provides 24 megabytes of fully usable unformatted capacity. Unique BASF circuitry eliminates user mapping.

Easy System Integration. BASF's exclusive SMD interface option offers cost-effective and convenient interface compatibility with industry-supported controllers. Low-cost BASF disk bus, or intelligent BASF host bus with integral controller/formatter also available.



Proven Reliability. BASF, because of its experience in both magnetic media and drives, is highly qualified to develop drives using reliable 3350 Winchester technology. BASF 6170 drives have a 10,000 hour MTBF and require no scheduled maintenance or operator intervention.

Compact Size. Far smaller than 14" drives, the quiet, lightweight floppy-sized BASF 6170 drives are suitable for desktop office environments.

Competitive Price. Get the performance, capacity, and ease of system integration you need right now... at prices you'd expect to pay for far less sophisticated technology. Write now for competitive OEM prices.

If you need high performance, capacity, easy system integration, proven reliability, in a compact size, at a competitive price, right now...

write now.

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Please send me complete details and specifications on the new BASF 6170 Series 210mm Fixed Disk Drives.

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Company _____

Address _____ Telephone _____

City _____ State _____ Zip _____

In a hurry? Call Dave Edwards at (617) 271-4168 CD

BASF

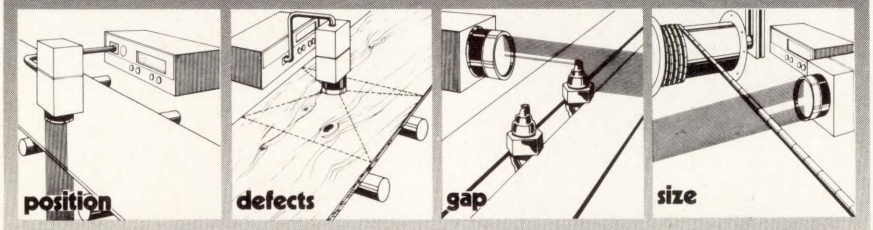
BASF

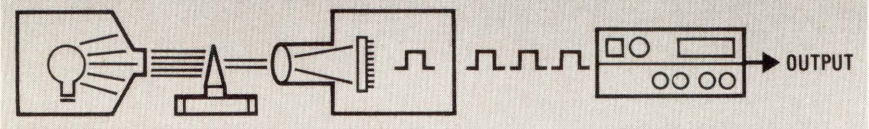
CIRCLE 197 ON INQUIRY CARD

LOOK AT YOUR PRODUCTS WITH A NEW EYE!



Image Sensing Systems from Reticon

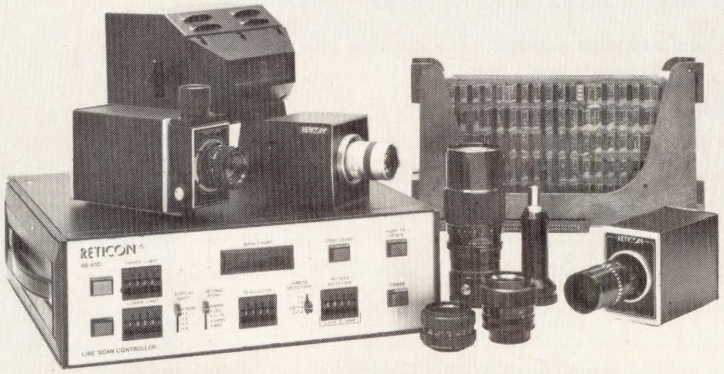




Unlike film cameras, an image is focused on an array of photodiodes which are precisely aligned on a single chip located inside the camera. This photodiode array converts light energy into corresponding electronic signals. The intelligent controller uses these signals to collect production information, process data, make process decisions, and talk to computers and control equipment.

Reticon Image Sensing Systems can be configured for practically any production application requiring non-contact inspection, measurement, detection, counting, sorting or monitoring. Choose the system components you need from a broad range of line scan or matrix cameras, lenses, illuminators, power supplies and intelligent controllers. There are even Interface Units that connect cameras to SBC–80 Computer Systems. And you can modify or expand your system to meet changing requirements.

Reticon's experience and technical services can help you define an imaging system that's right for your requirements. Write or phone for our applications brochure that describes our systems approach.



EG&G RETICON

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Boston (617) 745-7400, Chicago (312) 640-7713, Tokyo, Japan 03-343-4411, Bracknell, England (0344) 53618

LITERATURE

Prefab Enclosures

Catalog illustrates with photos and dimensional drawings line of enclosures that includes rack-mounting chassis kits and parts, card cages, and data terminal cabinets. **Techmar Corp,** Los Angeles, Calif.
Circle 350 on Inquiry Card

Algorithm Pattern Processor

APP memory test option for L135 series functional board testers that test RAMs and ROMs while the L135 tests board logic is introduced in data sheet. **Teradyne, Manufacturing Systems Div,** Boston, Mass.
Circle 351 on Inquiry Card

Printing Data Logger

Brochure lists specs, explains controls and displays, gives operating instructions, and provides block diagrams and application notes for PDL-10 10-channel analog voltage meter. **Datel-Intersil,** Mansfield, Mass.
Circle 352 on Inquiry Card

Programmable Controller

Introduced in brochure, the 584 performs relay, counter, and timer functions; does computer-like calculations; and controls and reports on analog and numeric data. **Gould, Inc, Modicon Div,** Andover, Mass.
Circle 353 on Inquiry Card

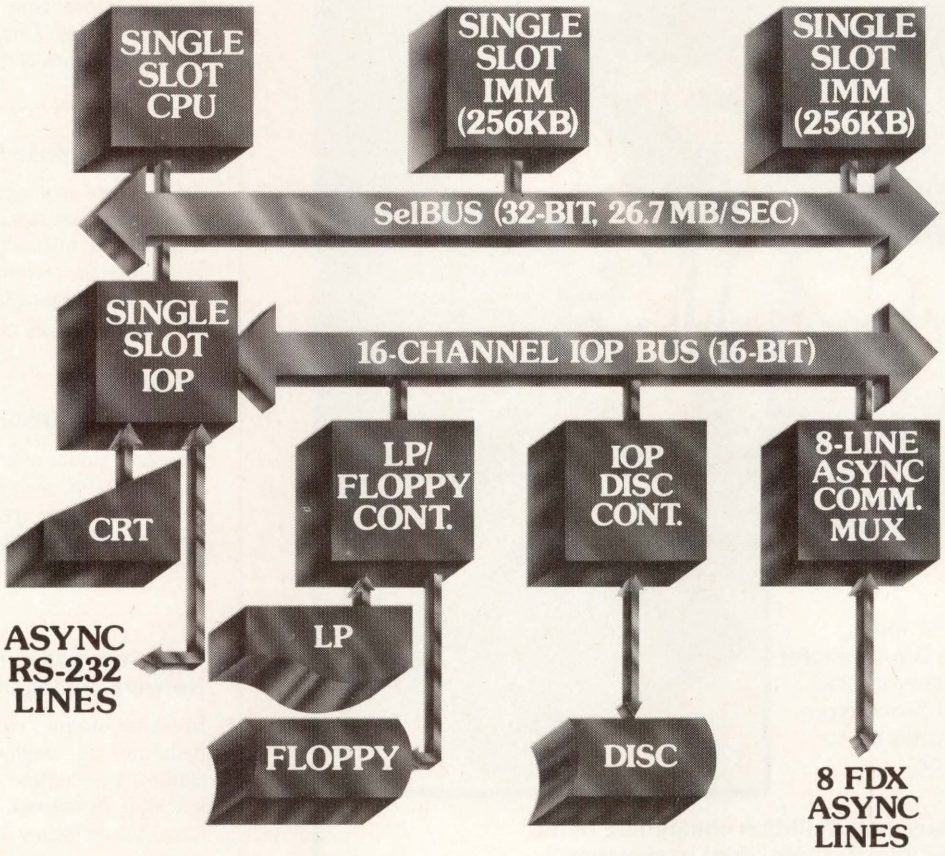
Timers, Counters, And Display Drivers

Applications handbook supplies features, specs, pin configurations, block diagrams, and recommended application circuits for universal counters, counter/display drivers, ICs, and timers. **Intersil,** Cupertino, Calif.
Circle 354 on Inquiry Card

Electronic Test Accessories

Catalog specifies accessories including binding posts, cable assemblies, and test socket adapters; and features temperature conversion tables, metric conversion chart, and BNC and tri-axial cable procedures. **ITT Pomona Electronics,** Pomona, Calif.
Circle 355 on Inquiry Card

A low-end 32-bit mini designed for the OEM. Introducing CONCEPT/32™



The trouble with most small minicomputers is that they started out as big minis and were simply scaled down. Same functionality. Similar performance. Lower cost. (You've seen the ads). If you're an OEM, you also know those "minis" retained all their complexity. Big mini interfaces. Expensive memory. Costly device controllers. Complex architecture. A big machine, in a cumbersome cabinet. Functionality? Sure. But with all the problems still there for you to solve with your bucks.

Now there's a better way. Want to move to 32-bit mini functionality, without investing in the problems? CONCEPT/32 is your answer. A single slot LSI processor with the proven 26.7MB SelBUS.

Integrated Memory Modules (**IMM**) for faster data access, more functionality, and single-slot memory in 256kB increments. An I/O Processor (**IOP**) to off-load I/O management functions from the CPU and make the total system more efficient. Specially designed intelligent **IOP controllers** on a unique, smaller IOP bus for "friendly I/O and interfacing." Control Panel functionality on the console CRT. And all with enhanced reliability, lower cost, and requiring 40 percent less power than any comparable mini.

Full 32-bit mini functionality. Designed right, for less. Hard to conceive? Call or write us for further information. Get into 32-bit technology with CONCEPT/32 from SYSTEMS.

SYSTEMS

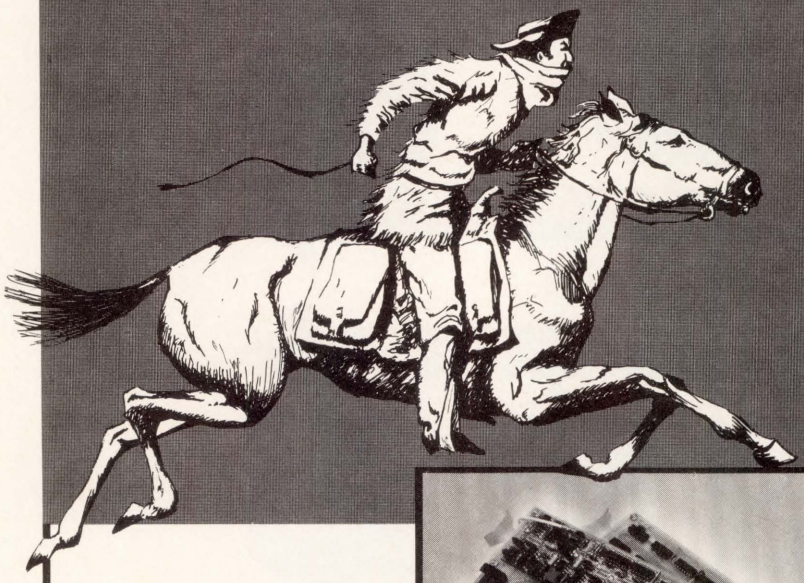
Proven COMPUTER Performance

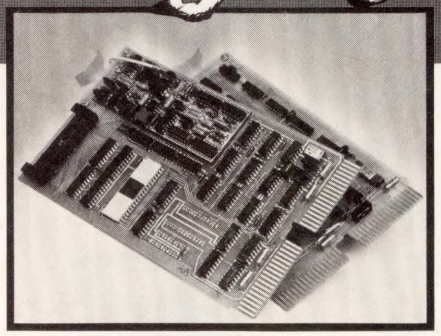
SYSTEMS toll-free product-information service 1-800-327-9716
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1980

CIRCLE 300 ON INQUIRY CARD

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- **Software compatible drivers available.**
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**DEC, Q bus, and Unibus are trademarks of the Digital Equipment Corporation. Intel and Multibus are trademarks of the Intel Corporation.*

LITERATURE

Integrated Circuit Packaging

Catalog contains information on nine panel sizes and appropriate rack assemblies, the Mixer system that allows three board sizes to plug into the same rack, and 2-piece connectors. **Mupac Corp,** Brockton, Mass.
Circle 356 on Inquiry Card

General Purpose Memory Systems

Architecture and operation for Series 90 general purpose memory systems with word lengths to 88 bits and word transfer rates to 110M bytes/s are described in brochure. **Intel Corp,** Santa Clara, Calif.
Circle 357 on Inquiry Card

Gas Plasma Displays

Selection guides offer photos, descriptions, and specs for SELF-SCAN[R] single-row and multiregister gas plasma displays. **Burroughs OEM Marketing,** Detroit, Mich.
Circle 358 on Inquiry Card

Data Communications Network Management

Brochure outlines equipment options from multi-unit to single-cabinet systems, including RASP remote access switching and patching. **Spectron,** Moorestown, NJ.
Circle 359 on Inquiry Card

Switching Power Supplies

Features, specs, dimensional views, and options for seven series of 175-W quad-output switching power supplies are described in catalog. **Deltron, Inc,** North Wales, Pa.
Circle 360 on Inquiry Card

Optoelectronic LEDs

Catalog includes electro-optical characteristics and mechanical dimensional drawings for LED lamps, display modules, and custom onboard display assemblies. **Opcoa,** Edison, NJ.
Circle 361 on Inquiry Card

Optical Badge Reader

Brochure furnishes mounting diagram, timing diagram with explanation, wiring diagrams, termination diagrams, and badge specs for solid state DSR-579. **Sealectro Corp,** Mamaroneck, NY.
Circle 362 on Inquiry Card

Customize for high performance. . .

If you need a high performance display terminal, go to the top.



Talk to us.

Our DELTA 7000 Series 16-bit microprocessor display terminals are the most advanced available. What makes them different from all the others, is that we can make them *so different* for you. Simply by *customizing* their standard features to precisely meet your special application. We've done it differently for many organizations around the world, and we're ready to do it for you now.

All DELTA 7000 Series display terminals include these special features:

- Independent split screens
- Large scrolling text memory
- Programmable function keys
- Multiple character sets

The Associated Press did.

We've also built special DELTA 7000 Series terminals for the National Institutes of Health, Hughes Aircraft, Commodity News Service, Black Dot and many other organizations.

Talk to us about your high performance terminal requirements today.

CIRCLE 302 ON INQUIRY CARD



The Associated Press Mighty Mouse System is the most advanced wire service copy processing network in the world. Over 300 Delta display terminals are used in this system.

Courtesy Associated Press

Delta Data Systems Corporation

DELTA DATA SYSTEMS CORPORATION
Woodhaven Industrial Park
Cornwells Heights, PA 19020
(215) 639-9400
See us at NCC, Booth 1308, 1310

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GUIDE TO PRODUCT INFORMATION

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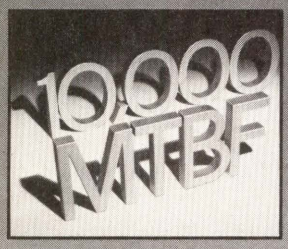
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RELIABILITY. IT'S WHAT MAKES FUJITSU THE WORLD'S LARGEST MANUFACTURER OF OEM WINCHESTERS.



That's right! Fujitsu produces more Winchester technology disk drives for the OEM market than any other manufacturer in the industry. The reason for this success is the unequalled reliability of Fujitsu products.

For instance, Fujitsu's M228X Winchester drive delivers more than 10,000 MTBF power on hours of high performance. That's 40% better than the industry standard. And the M228X is fast: 6ms track-to-track (27 ms average) access time. With this kind of performance, up to 169 megabytes of unformatted storage, and Fujitsu's competitive pricing—there is no other choice! Optional head-per-track capacity of 655 kilobytes also available with this series.

80 and 50 MB cartridge drives with SMD interfacing

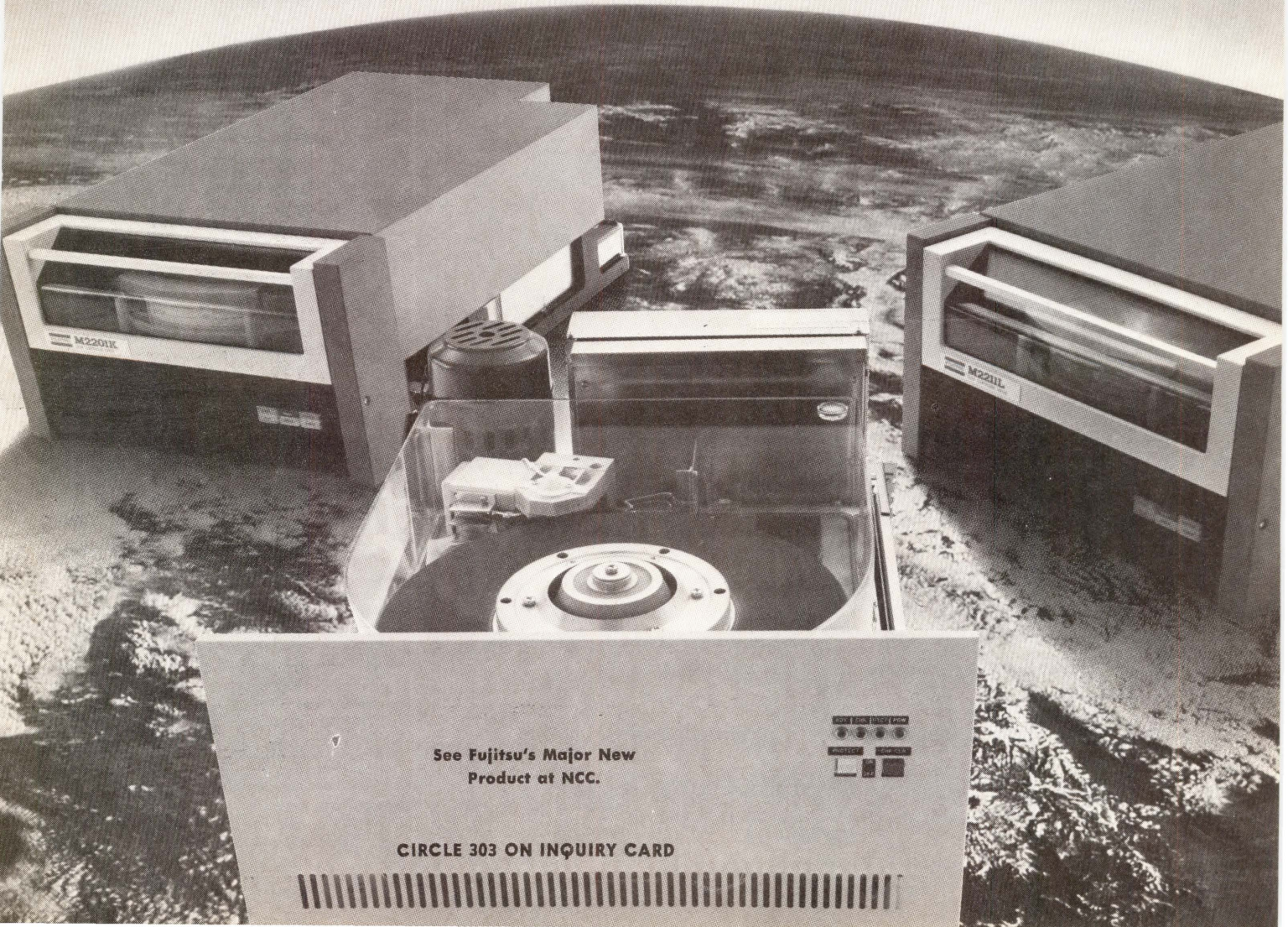
Fujitsu's advanced technology does not stop at Winchesters! The two front-loading cartridge drives with SMD capability shown here, have statistics only Fujitsu could guarantee. Like access times of 6ms track-to-track (30 ms average), and a reliability factor of over 6,000 poh MTBF. That's 50% better than the industry standard.

And whether you order the M2211 (80 MB) or the M2201 (50 MB) drive you can say goodbye to data staging. Plus you get a servo/track record system that assures the cartridge interchangeability you need. With features like these it's no wonder Fujitsu's got the world on a platter.

For technical information, (outside California only) phone toll-free 800-538-8175. For sales and service, or evaluation unit, contact: Fujitsu America, Inc., 2945 Oakmead Village Court, Santa Clara, CA 95051. Phone 408-985-2300, Telex 357-402, TWX 910-338-0047.

FUJITSU

The first word in reliability.
The last word in performance.



See Fujitsu's Major New Product at NCC.

CIRCLE 303 ON INQUIRY CARD

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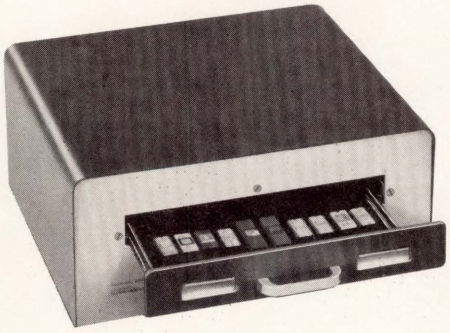
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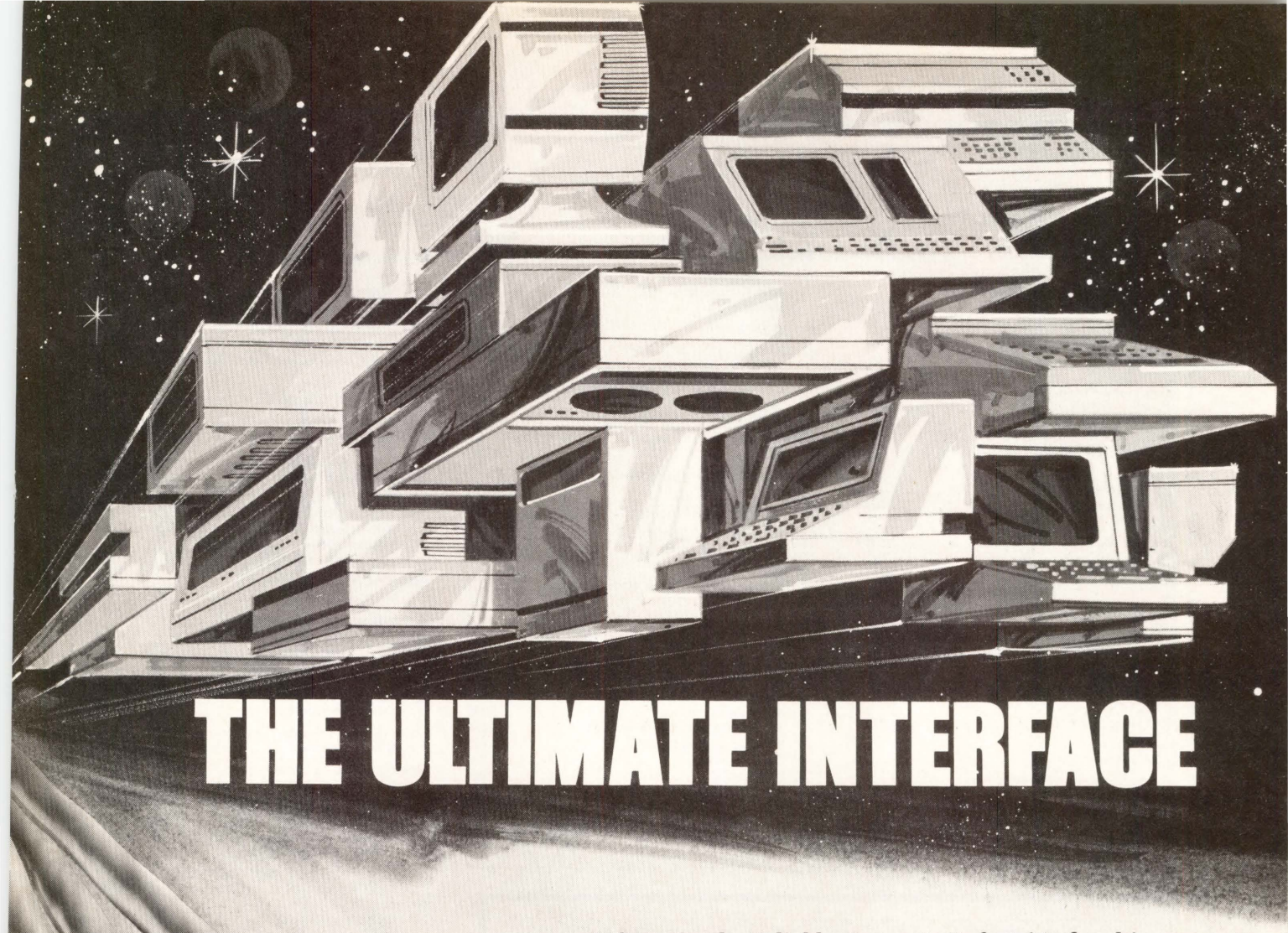
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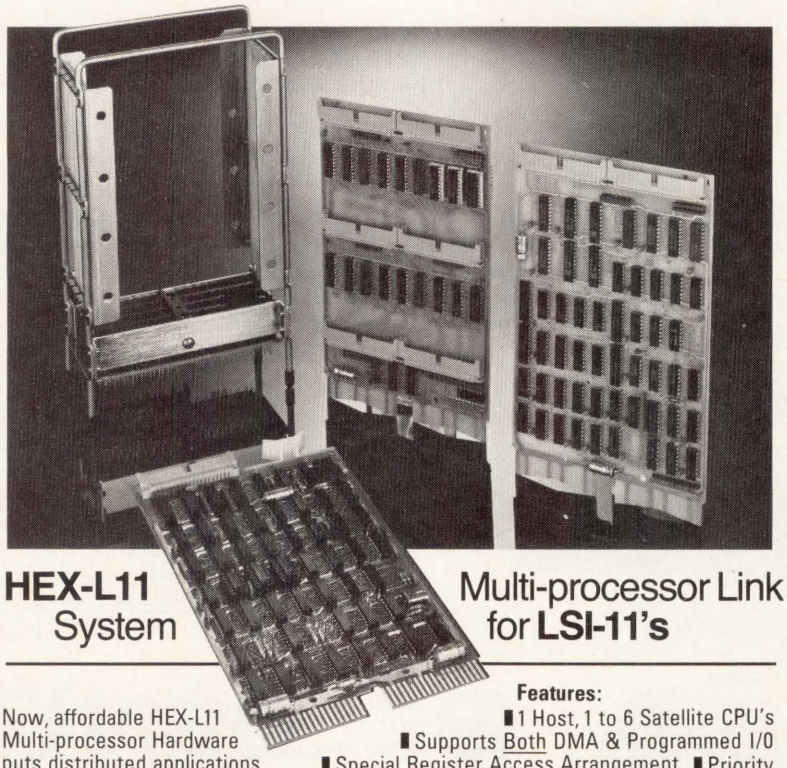
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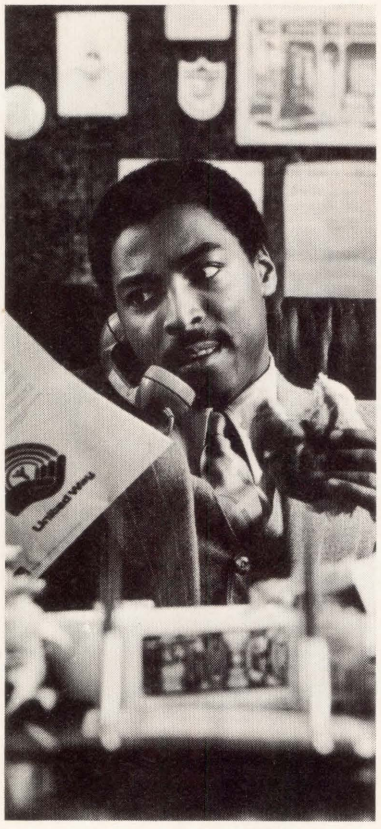
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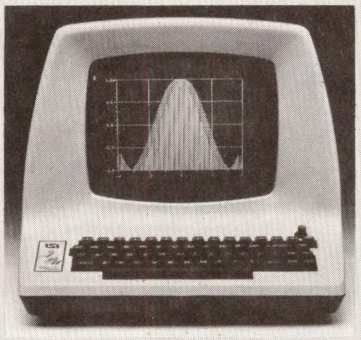
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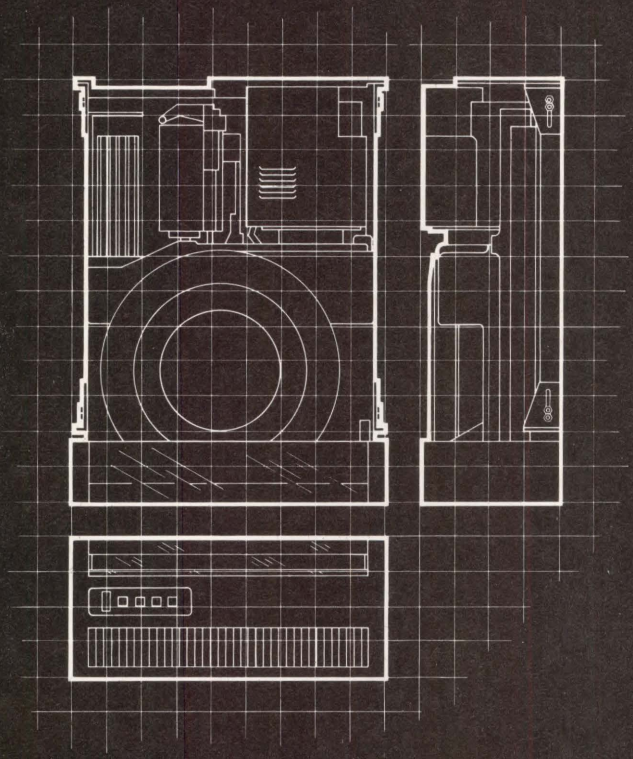
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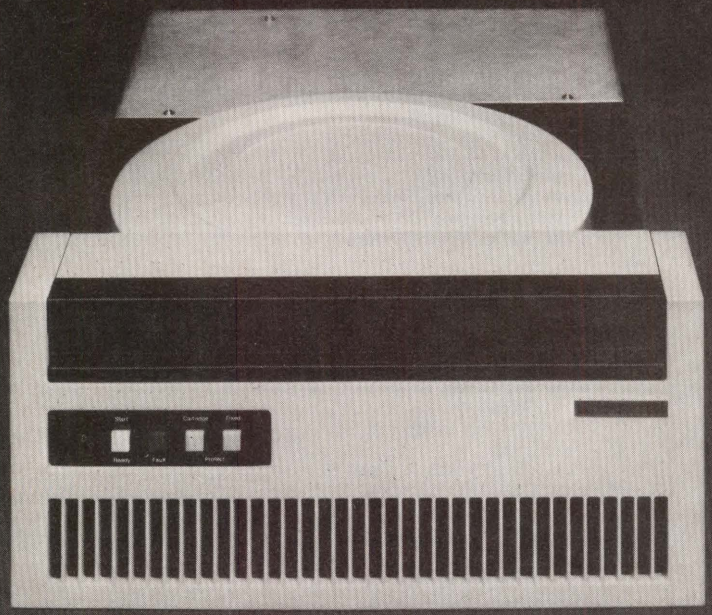
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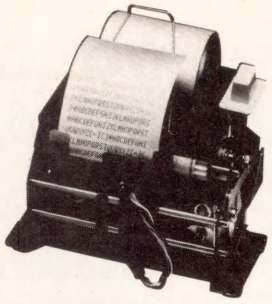
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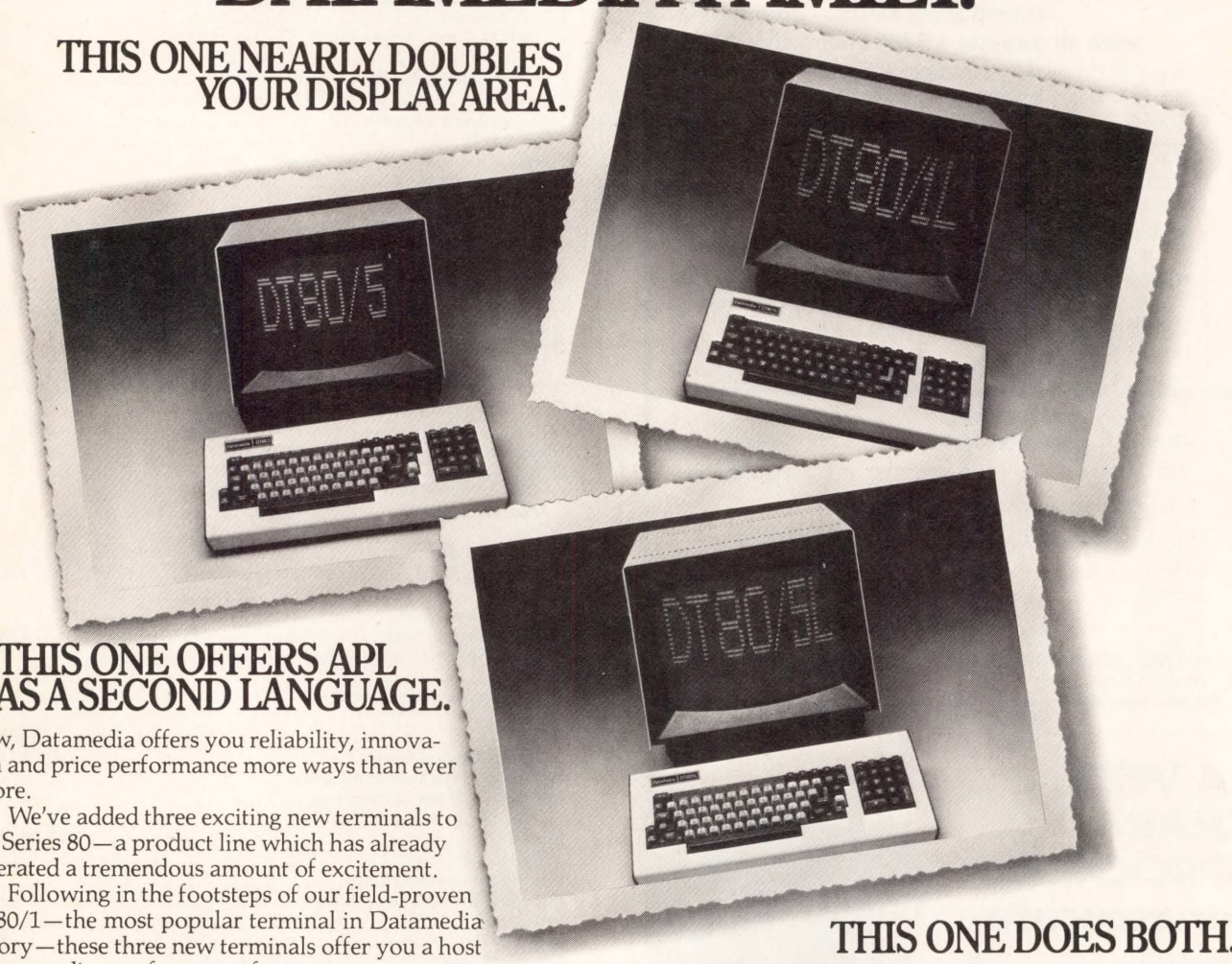
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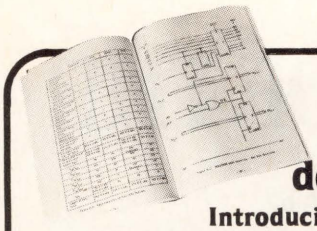
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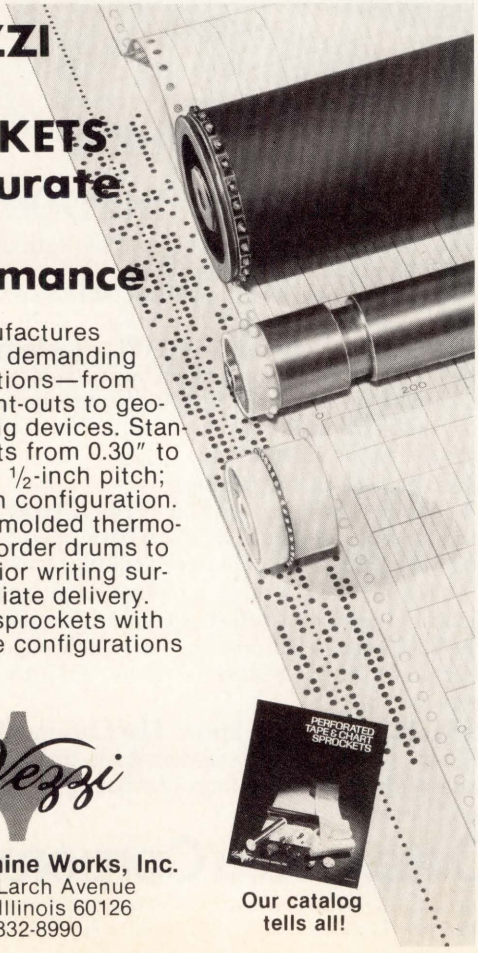
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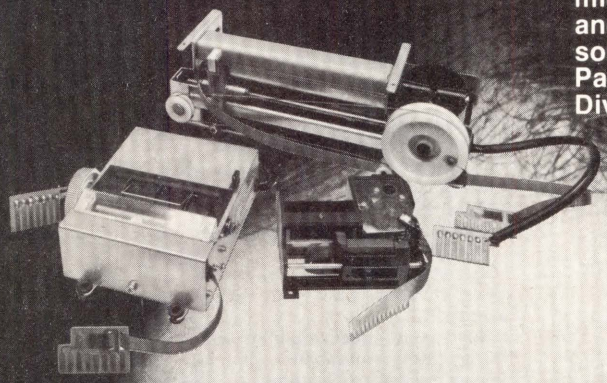
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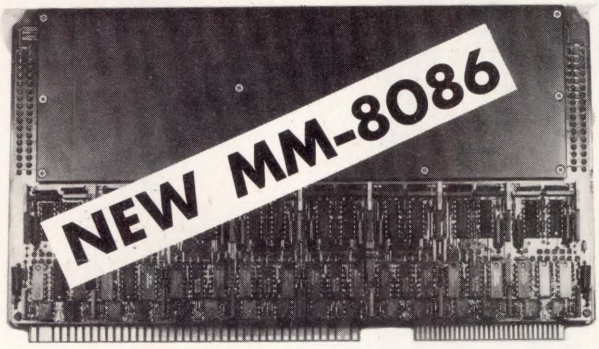
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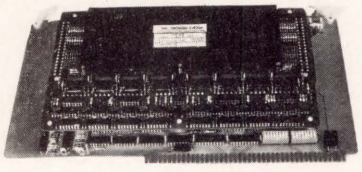
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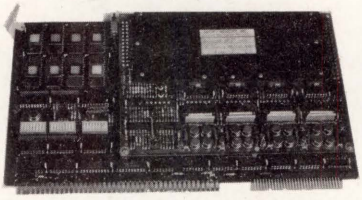
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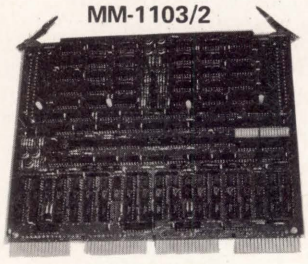
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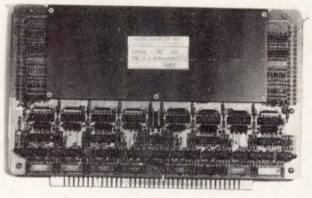
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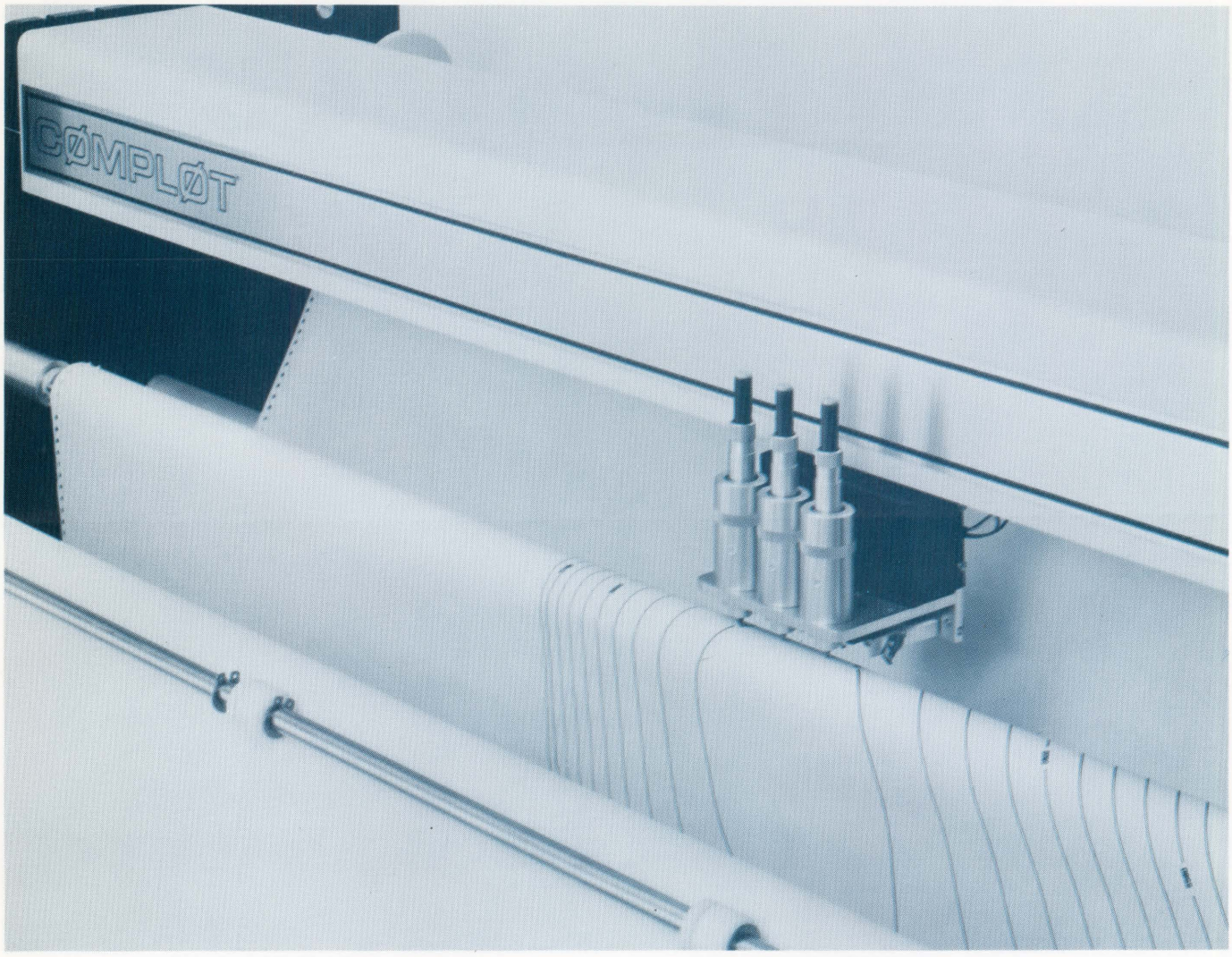
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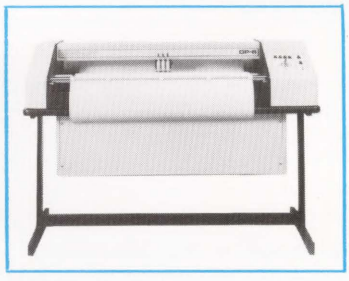
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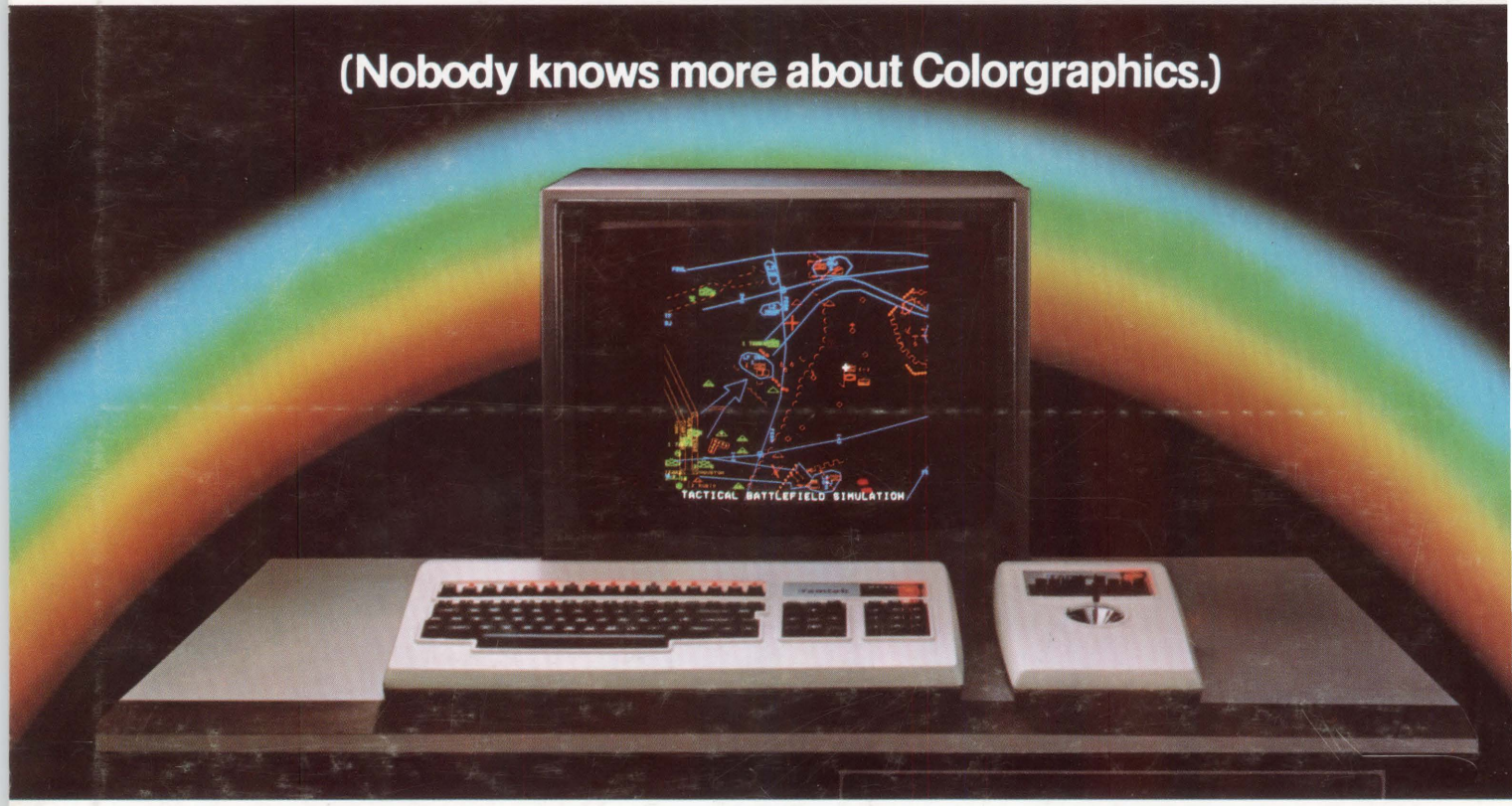
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